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Final Report

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Archaeological Investigations at the North Cove Site Harlan County Lake Harlan County, Nebraska

An Interdisciplinary Approach

Prepared by:

Kaw Valley Engineering & Development, Inc.
Junction City, Kansas
Parkville, Missouri

Submitted to:

U.S. Army Corps of Engineers
Kansas City District
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FINAL REPORT

ARCHAEOLOGICAL INVESTIGATIONS AT THE NORTH COVE SITE HARLAN COUNTY LAKE, HARLAN COUNTY, NEBRASKA

An Interdisciplinary Approach

Edited by
Mary J Adair

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Mary J Adair

An Archaeological Project Conducted for the Kansas City District of the U S Army Corps of Engineers
Contract No DACW41-85-C-0167 Modification P00003

Submitted by
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The following report summarizes the archaeological Phase II testing of the North Cove site (25HN164) for National Register eligibility in Harlan County Lake, southcentral Nebraska. An interdisciplinary investigation of the exposed 9-meter deposit included the mechanical removal of the overburden, manual excavation of the Late Wisconsinan aged deposits and extensive flotation for the recovery of significant paleontological, paleoecological and archaeological data. Four small unmodified flakes were recovered from the Late Wisconsinan deposits while a series of stratigraphically consistent radiocarbon

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dates from the site indicate they are of pre-Clovis age. A geomorphic history of the site however, reveals that the artifacts were not recovered from their original point of deposition but were redeposited as part of slump or as colluvial sediments from a location upslope, or northwest, of the location of the excavations. Despite the incredible amount of significant paleontological and paleoecological data recovered from the site and despite the presence of unquestionable human artifacts in association with the Late Wisconsinan sediments, it was concluded that the original pre-Clovis site was not exposed during the investigation process and therefore could not be recommended for eligibility to the National Register.

Abstract

This report summarizes the archaeological Phase II testing of the North Cove site (25HN164) for National Register eligibility in Harlan County Lake, southcentral Nebraska. The project was funded by the Kansas City District of the US Army Corps of Engineers, DACW41-85-C-0167, Modification P00003, in contractual agreement with Kaw Valley Engineering and Development, Inc of Junction City, Kansas and Parkville, Missouri. The objective of the project was to minimally test the North Cove site in order to determine its cultural integrity and potential eligibility for nomination to the National Register of Historic Places.

An interdisciplinary investigation of the exposed 9-meter deposit included the mechanical removal of the overburden, manual excavation of the Late Wisconsinan aged deposits and extensive flotation for the recovery of significant paleontological, paleoecological and archaeological data. Four small unmodified flakes were recovered from the Late Wisconsinan deposits while a series of stratigraphically consistent radiocarbon dates from the site indicate they are of pre-Clovis age. A geomorphic history of the site however, reveals that the artifacts were not recovered from their original point of deposition but were redeposited as part of slump or as colluvial sediments from a location upslope, or northwest, of the location of the excavations. Despite the incredible amount of significant paleontological and paleoecological data recovered from the site and despite the presence of unquestionable human artifacts in association with the Late Wisconsinan sediments, it was concluded that the original pre-Clovis site was not exposed during the investigation process and therefore could not be recommended for eligibility to the National Register.

Table of Contents

Table of Contents (continued)

List of Tables

List of Figures

List of Figures (continued)

Acknowledgments

As editor, I would like to thank all of those who contributed to the successful completion of this project and report. First, the authors are thanked for their contributions in the field, in the lab and occasionally even over the phone. Dr Brad Logan of the Museum of Anthropology, University of Kansas, directed the fieldwork and authored several chapters. Since my institutional affiliation is also the Museum of Anthropology at KU, I frequently consulted with Brad on various issues. Dr William C Johnson, geomorphologist with the Department of Geography, University of Kansas, made several trips to the North Cove site and worked patiently with us to succinctly describe the very complex stratigraphy of the site and argue for a pre-Clovis age of the artifacts. Glen C Fredlund, a doctoral candidate in the Department of Geography at KU provided a comprehensive identification of the plant pollen and macrofossils from the critical deposits at North Cove. Dr J D Stewart, a paleontologist with the Natural History Museum of Los Angeles County, enthusiastically collected many samples during field work and consequently spent many hours in the lab identifying the 40 plus species of molluscs, amphibians, fish, reptiles, birds and mammals from the Late Wisconsinan deposits. I am happy to have had the opportunity to work with such a dedicated team and have learned much about their various fields.

Thanks are also given to personnel at the Kansas City District, US Army Corps of Engineers, for awarding the original contract to Kaw Valley Engineering and Development, Inc and for modifying this contract to focus directly on the North Cove site. Personnel at the Corps office at the Harlan County project area are also acknowledged for their assistance, which at times came at very critical moments.

The crew who worked for many hours along the vertical bluff are thanked for their efforts and attention to detail. Directed by Dr Logan, the crew consisted of Bill Ranney, Mike Fosha, Cheryl Fosha, Steve Bozarth and Chuck Martin. In the lab at the Natural History Museum in Los Angeles, Ann Martin and Robert Leedy spent many hours sorting the flotation matrix.

Certain individuals provided assistance in particular instances. Dr Larry Martin of the Vertebrate Paleontology Department at the University of Kansas helped in the identification of the bird remains. In addition, his department provided tools, equipment and support to the project. Dr Richard M Forester of the Paleontology and Stratigraphy Branch of the USGS in Denver provided identification of a few ostracodes. Dr Jeheskel Shoshani of the Department of Biological Sciences, Wayne State University, Detroit, confirmed the identification of the mastodon vertebrae found along the shore of the North Cove site. Steve Holen, now a doctoral student at the Museum of Anthropology, University of Kansas, extended his advice on the identification of the Upper Republican jasper.

This project would have not been possible if it were not for the personnel at Kaw Valley Engineering and Development, Inc. Leon Osbourn deserves special thanks for taking a risk in pursuing this cultural resource management project. Field surveyors, cartographers and secretarial personnel associated with Kaw Valley Engineering all deserve special credit and thanks.

CHAPTER 1

BACKGROUND AND DESIGN OF THE DATA RECOVERY PROJECT: NORTH COVE (25164), HARLAN COUNTY, NEBRASKA

MARY J ADAIR

The North Cove site (25HN164) is an approximately 9 meter exposure of sediments dating from mid-Pleistocene to recent times visible on an eroding face of North Cove on Harlan County Lake, Nebraska. The site is located in southcentral Nebraska (Fig 1) on the west side of a channel that once was a tributary of the Republican river. Exposed by a series of processes such as wave action and erosion, following the construction of Harlan County Lake in 1952 by the US Army Corps of Engineers, this site has been the focus of extensive research. The exposed sediments have yielded varying amounts of data significant to archaeological, paleontological and paleoecological research. This report focuses on the human occupation represented in four small artifacts retrieved from deposits of pre-Clovis age. A critical part of this occupation was the adaptation to an environment very different from that of southcentral Nebraska today. Therefore, this report describes the paleoenvironmental, paleoecological and paleontological setting as reconstructed from data retrieved from the same stratigraphic units as the artifacts.

North Cove was first recognized professionally in 1983 by J D Stewart, a paleontologist now with the Los Angeles County Museum of Natural History, and Philip Wells, a botany professor from the University of Kansas. They were involved in a survey of Wisconsinan age sediments in Kansas, Nebraska and Colorado. They visited the north shore of Harlan County Lake where they noticed an apparent paleo-channel cut into the Peoria loess, exposed in a 9-meter cliff. Over the next month, repeated visits to the site resulted in a collection of aquatic and terrestrial vertebrates and invertebrates of both Late Pleistocene and Holocene age; charcoal and wood fragments, including needles and cones of white spruce (*Picea glauca*); and a flake of heat treated chert. The association of abundant plant and animal remains with a possible human occupation in terrestrial (Woodfordian) sediments indicated that the site was of major scientific importance. Dr Stewart notified the U S Army Corps of Engineers, who controls Harlan County Lake, of the potential significance of this site as well as its endangered situation due to wave action and erosion.

The Kansas City District, U S Army Corps of Engineers was in the process of formulating a contract to test 27 known prehistoric and historic archaeological sites located on the boundaries of Harlan County Lake for National Register

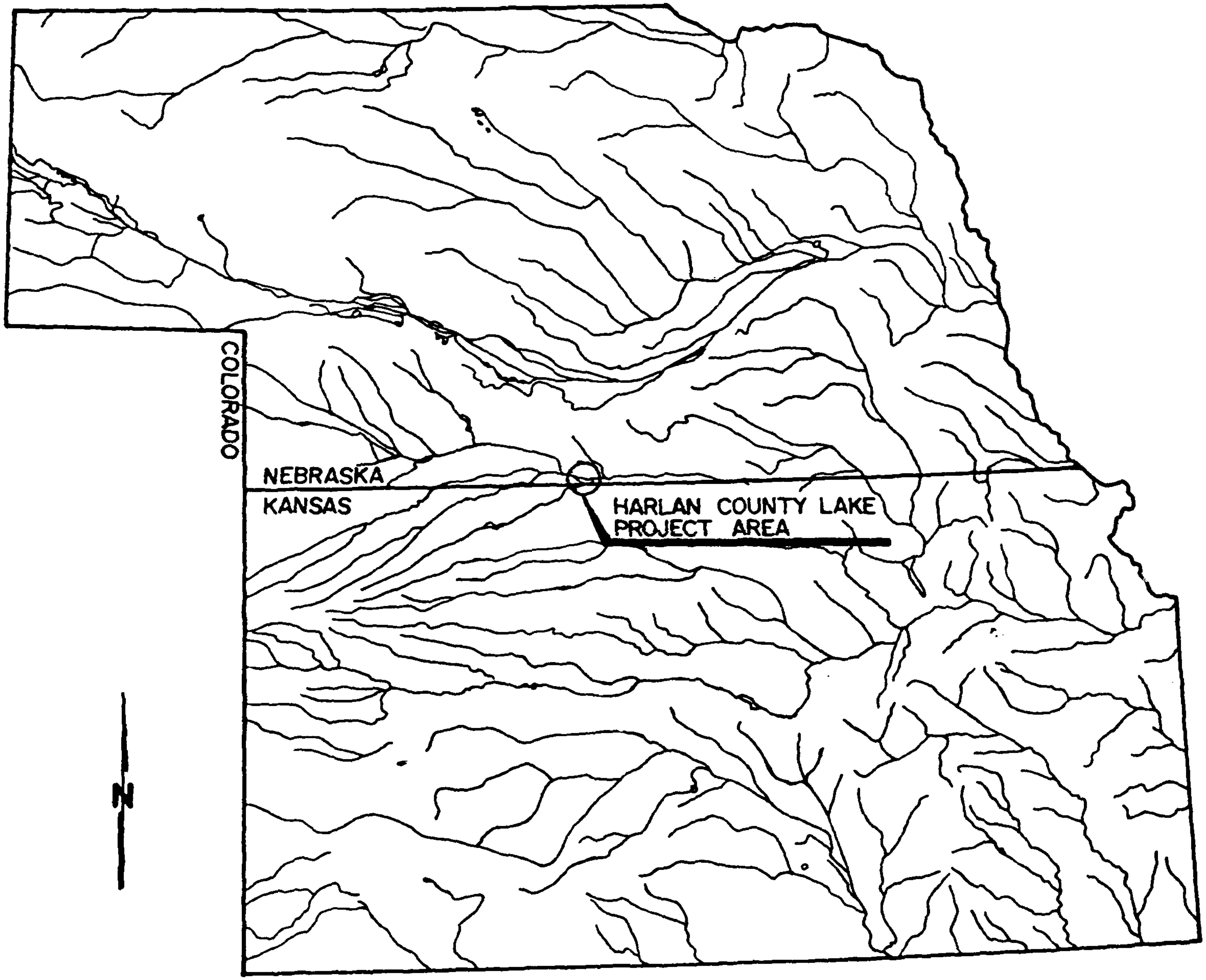


Figure 1. Location of the North Cove site (25HN164), Harlan County, Nebraska.

significance. The Quaternary deposits reported at North Cove were added to this list and archaeological investigations were initiated in 1985. This testing program was designed to recover data necessary to address issues of site size, integrity, cultural affiliation and significance. At the North Cove site excavation techniques included soil coring, backhoe trenching, soil profiling and extensive flotation of sediments from natural stratigraphic units visible in the 9-meter exposure. These tests yielded abundant macrofloral and macrofaunal remains of Late Wisconsinan age, species of which had not previously been reported for the Central Great Plains; abundant pollen and phytoliths from both Late Wisconsinan and early Holocene deposits; an edge modified piece of quartz recovered from the Late Wisconsinan sediments; and stratigraphically consistent radiocarbon dates ranging from 14,700 $\pm$ 100 to 10,120 $\pm$ 405 yrs B.P. (Adair and Brown 1987).

The artifact was recovered from a geologic screen during excavation, along with faunal remains of Late-Pleistocene age. It measures approximately 17 mm in length and 14 mm in width and exhibits lateral edge modification. Since it lacks critical morphological characteristics of a flake, it has repeatedly been referred to as a quartz piece, or assuming original morphology was more definitive, a flake fragment. This artifact was argued to represent evidence of human occupation during the Paeloindian period, despite its recovery in a screen. Contamination of the Late-Pleistocene deposits was considered extremely unlikely (Adair and Brown 1987:282) as care was taken to keep the vertical surface clearly exposed during profiling. Analyses of the macrofloral, macrofaunal, pollen, phytolith and sediment remains provided an excellent picture of the Late-Wisconsinan environment to which this Paleoindian occupation adapted. Based on the results of these investigations and analyses, recommendations were made to the Corps (Adair and Brown 1987) for further and immediate Phase II testing at the North Cove site. This testing was awarded to Kaw Valley Engineering and Development, Inc as a modification to the original contract.

In the fall of 1987, an interdisciplinary team of archaeologists, a paleontologist and a geomorphologist spent 5 weeks at the North Cove site, systematically investigating the various stratigraphic deposits. Specific reasons for this investigation focused on 1) documenting the presence of a Pre-Clovis human occupation in an undisturbed context; and 2) reconstructing the environmental setting to which the humans adapted. Results of the interdisciplinary investigation are detailed in the seven chapters of this report. Although there is a wide range in specialties among the authors, everyone collaborated to provide a thorough and complete description of this site, its archaeological and paleoenvironmental significance, and its value in regional studies.

The recovery techniques and methods were designed to carefully extract archaeological, paleontological, and paleoecological data. As discussed in Chapter 2 by Brad Logan, this included manual excavation of selected strata, complete flotation of all Late terrestrial deposits, extensive documentation and removal of the top 6 meters of overburden to expose the Late terrestrial deposits.

Since the artifacts were recovered in association with deposits also yielding paleoenvironmental and paleoecological data, the pre-Clovis environmental setting could be reconstructed to provide for an understanding of human adaptation. Chapters 3 and 4 focus on the paleoenvironment. In Chapter 3, by William C Johnson, the site stratigraphy is delineated and the late Quaternary landscape evolution is described. A complete listing of all radiocarbon dates from the North Cove site and other Harlan County Lake sites is provided. In addition, terminology of the complex stratigraphic units was simplified from an original identification of eight units (Adair and Brown 1987) to four major units. As discussed in further detail in Chapter 3, these four units adequately define the series of events responsible for the formation of the various strata. More importantly, this chapter provides a good picture of the paleolandscape of the North Cove site.

A picture of the paleolandscape is further enhanced with the data presented in Chapter 4 by Glen C Fredlund. Spring deposition at the North Cove site during the Late Wisconsinan resulted in the preservation of pollen and botanical macrofossils. These data document the presence of an open, mixed spruce-deciduous parkland that included many taxa potentially important as resources to prehistoric occupations.

Chapter 5 by J D Stewart describes the paleontology and paleoecology of the North Cove site. Focusing on the abundant fossils recovered from the artifact bearing stratigraphic units, Stewart provides an extensive list of the various taxa of invertebrates and vertebrates, some of which have never been previously recorded from the Great Plains. In addition, many of the taxa, particularly the molluscs, are strong climatic indicators and help document the environmental setting for prehistoric populations. In at least one instance, Stewart argues that small fragments of burned bone, presumably bison, are evidence of this former human occupation.

As discussed in Chapter 6 by Brad Logan, the artifacts recovered from both 1985 and the 1987 investigations were extracted from a lens of silty clays with intermixed sands located approximately 7 meters below ground surface. Radiocarbon dates from the organic rich spruce zone which caps this silty clay lens are 14,700±100; 13,100±140;

12,965±135; and 12,650±250 yrs B.P. This makes the artifacts of pre-Clovis age, the earliest human occupation in North America associated with a diagnostic tool. The validity of the pre-Clovis period is one of the most controversial problems in current archaeological research in the New World. The issues involved in this controversy are discussed in greater detail in Chapter 6. The artifacts recovered from the North Cove site are also discussed in detail in this chapter.

In the final chapter, Chapter 7 by Mary Adair, the data presented in this report is summarized and issues of site significance and preservation are discussed. The North Cove site is somewhat unique in the central Great Plains in that it offers an incredible amount of information on changes in both the local flora and fauna and the landscape over a period of approximately 3000 years. To date, no other site in the area has yielded some of the information and representation of certain taxa as that recovered from North Cove. The human presence during the Late Wisconsinan is also a very unique and significant factor. It is also an extremely critical factor in the discussion of National Register eligibility.

CHAPTER 2

METHODS OF DATA RECOVERY

BRAD LOGAN

Introduction

Investigation of the North Cove site by Kaw Valley Engineering in 1985 yielded an abundance of Late Pleistocene faunal remains in stratigraphic association with a single retouched piece of quartz (Adair and Brown 1987:281-287). The latter find occurred at a depth of approximately seven meters in Profile No. 2 (Figure 2). In order to carefully document the provenience of any additional cultural materials, the most thorough archaeological methods of data recovery were applied during the 1987 investigation of the site. These methods included removal of culturally sterile overburden with heavy earth-moving machines and manual excavation of a series of test units in the area of Profile No. 2. In order to maximize recovery of cultural and biological remains, all fill from the Late Pleistocene deposits was subjected to flotation, a process described in detail below.

Excavation Methods and Techniques

Survey of the beach at the North Cove site by J D Stewart in 1984 resulted in discovery of a single flake. The primary source of this redeposited artifact is problematic. While it may have been derived from the Late Pleistocene strata at the site, alternative explanations include erosion from deposits overlying the Late Pleistocene sediments or redeposition by wave action from an as yet unrecorded site in the vicinity of North Cove. In order to determine if this artifact and any others that may yet appear on the beach at the North Cove site, could have been derived from higher deposits than those that were the focus of our attention in 1987, it was decided to conduct test excavations in the most likely candidate horizon for such finds. This horizon is a buried soil exposed at the site approximately four meters below surface and at a height of two to three meters above the Late Pleistocene deposits. This paleosol represents a period of surface stability. As such, it was believed to have a higher probability of containing cultural materials than any of the loessal or alluvial sediments overlying the Late Pleistocene deposits. As removal of a portion of this horizon was necessary in order to reach the latter, it was decided to first conduct a series of test excavations within it.

A 955 trackloader and a backhoe were used to remove more than 320 cubic meters of loess (including the thin surface

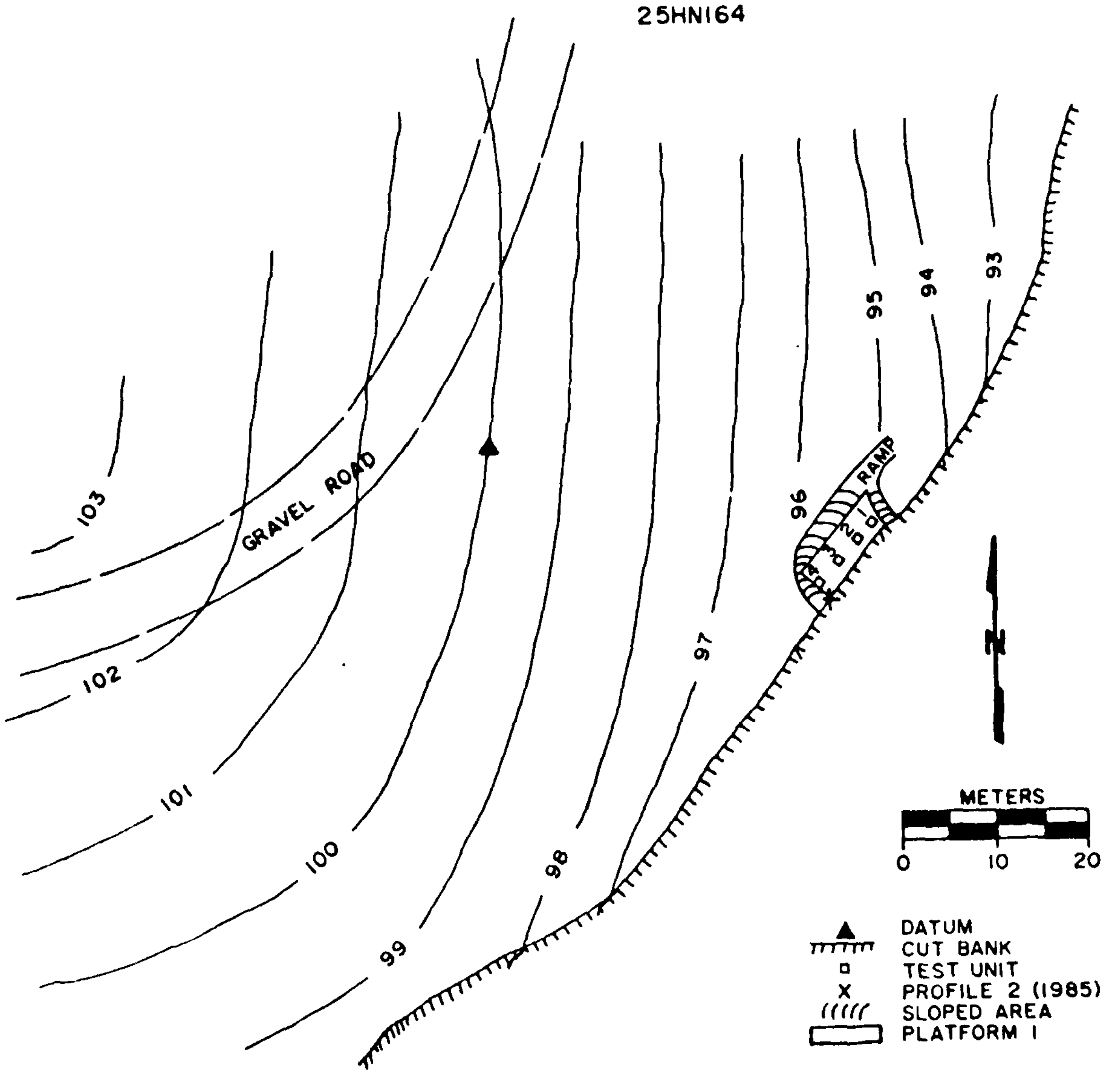


Figure 2. Plan view of the North Cove site showing the location of the first platform and test units. Note location of Profile 2 (x) from 1985 investigations.

soil) above the paleosol (Figure 3). A platform ten meters long (i.e., parallel to the bluff face) and five meters wide (i.e., perpendicular to the bluff face) was created at a depth of four meters below ground surface and at a height of approximately 30 cm above the buried soil horizon (Figure 4a). A series of four 1m(2) test units was defined on this platform with respect to the permanent site datum that had been established in 1985. The units occurred at intervals of two meters along a line paralleling the bluff face and at a distance of 1.25 meters from the edge of the platform (Figure 2).

The first level of Test Unit 1, the northernmost of the series, was excavated to a depth of 20 cm below the unit datum (i.e., the southwest corner of the unit) and subsequent levels of the unit were dug in ten cm intervals to a final depth of 100 cm below unit datum. All fill was dry screened through 1/4 inch hardware cloth. No cultural materials were recovered in what proved to be a well developed soil horizon. The remaining units were excavated in 20 cm levels and all fill was dry screened as above. No cultural remains were encountered. Test Units 2 (Figure 4b) and 4 were dug to a depth of 100 cm below unit datum; the west half of Test Unit 3 was excavated to depth of 130 cm below unit datum and the east half to a depth of 114 cm below unit datum. In all units the surface of paleosol was very distinct and encountered at a depth of 15 to 30 cm below the surface of the platform. Unit 3, the deepest of the series, provides the best representative profile: silt (loess) to a depth of 22 to 24 cm below unit datum; clayey silt (the paleosol) to a depth of approximately 72 cm; mottled soil of silty clay from an indistinct transition at ca. 72 cm to a thin (ca. two cm) band of compact, oxidized silt which ranged from 119 to 127 cm below unit datum (the base of the paleosol); clay to the bottom of the unit.

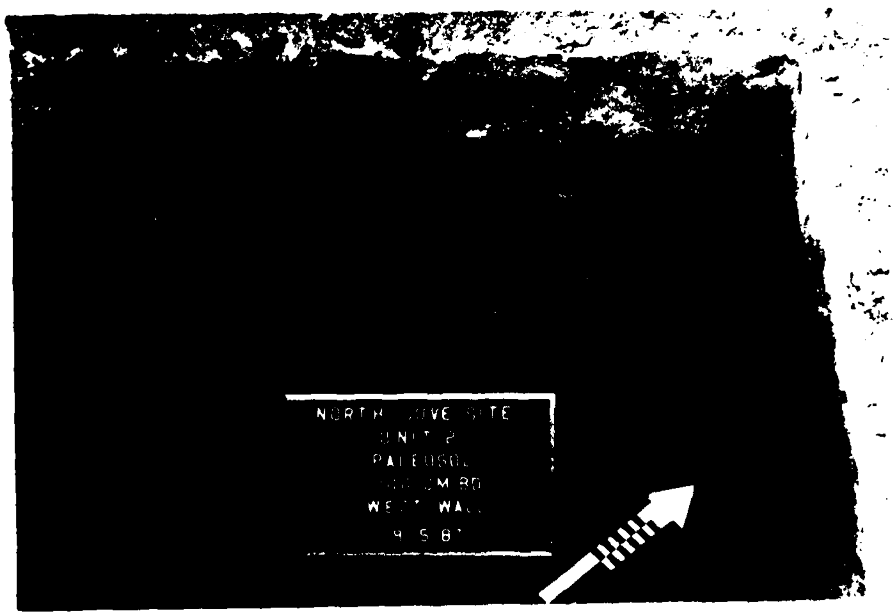
No cultural materials were found in any unit within the paleosol and the only sediments larger than silts or clays screened from more than four cubic meters of fill consisted of two large sand grains, both of which were found from 80 to 90 cm below unit datum in Unit 3. It can be assumed that the buried soil is not the source of any cultural materials at the North Cove site. Soil samples were collected for both radiocarbon dating (from the upper and lower portions of the soil profile) and for pollen/opal phytolith analysis (see subsequent chapters in this volume).

A second platform was then created approximately two meters below the first for the purpose of exploring the archaeological potential of the Late Pleistocene deposits. Investigations in 1985 had demonstrated that the sediments lying between the paleosol and the Wisconsinan spring deposits contained only sparse remains of large, extinct

Figure 3. Trackloader (background) and backhoe remove sterile deposits above the paleosol at the North Cove site.

A

Figure 4a. View from the beach of the excavation of test units on the first platform.



B

Figure 4b. West profile of Test Unit 2 in the paleosol (note rodent burrow filled with lighter colored loess from above the paleosol). The depth on the photoboard refers to the unit datum, or the surface of the platform. Actual depth of the base of this unit below surface is five meters.

bison (B. cf. occidentalis). Consequently, it was decided to remove this interval without the testing methods described above. Rather, samples of fill were collected from the face of the bluff along this horizon and water screened for archaeological and paleontological remains. None were encountered. Removal of more than 70 cubic meters of sediments was then accomplished with a 955 trackloader and backhoe. This operation was closely monitored by the crew in order to detect any disturbance of buried biological or cultural materials (Figure 5a). During this process, the author noted a fragment of bone uncovered by the backhoe in the extreme northwest corner of the platform at a depth of approximately six meters below surface. This bone was carefully preserved and removed by the Project Paleontologist and later identified as part of the innominate of an extinct bison (B. cf. occidentalis). No other remains were discovered in the excavated portion of this stratum.

The second platform was approximately seven meters long, five meters wide and one to two meters above the Late Pleistocene deposits that contained abundant vertebrate and invertebrate remains. A series of seven contiguous 1m(2) test units was defined along the bluff face with respect to the site datum (Figure 6). Test Unit A was the southernmost and Unit G the northernmost. The eastern face of units A through F was cleaned with picks, shovels, and trowels (Figure 5b); photographs were taken and detailed stratigraphic profiles were drawn (Figure 7).

The stratigraphy revealed along the face of the second platform was complex and the influence of piped spring water was noted in the displacement of fine sands upward into clays (Figures 8-9). The dark organic rich zone that in 1984 and 1985 had been the source of spruce wood, needles and cones was noted at a depth of 70 to 104 cm below the surface of the platform (i.e., 6.7-7.04 m below surface at the edge of the bluff). However, this "spruce zone", as it came to be called, was only a remnant of the once more extensive lens and provided evidence of the severe erosion that had occurred in the site area since 1985. The stratigraphy of the site is discussed in greater detail in chapter three.

Excavation of test units was with hand tools, including shovels and trowels, in ten cm levels. In those units where the "spruce zone" was present, that zone and its surrounding matrix were excavated and screened separately within each ten cm level. For example, the level in unit A that was 80-90 cm below the surface of the second platform contained a mosaic of clays and fine piped sands, defined as Level 9A and the dark brown organic rich clay "spruce zone", defined as Level 9B. Levels 9A and 9B were excavated and water screened separately. In lower levels of units that contained portions of the clay-sands, "spruce zone," and basal, cross-bedded

A

Figure 5a. Trackloader is used to remove slumped sediments from the face of the bluff while the backhoe is used to excavate sediments above the second platform. J. D. Stewart, Project Paleontologist, monitors backhoe removal of horizon containing bison bone.

B

Figure 5b. Crew cleans profile of Late Pleistocene deposits below second platform.

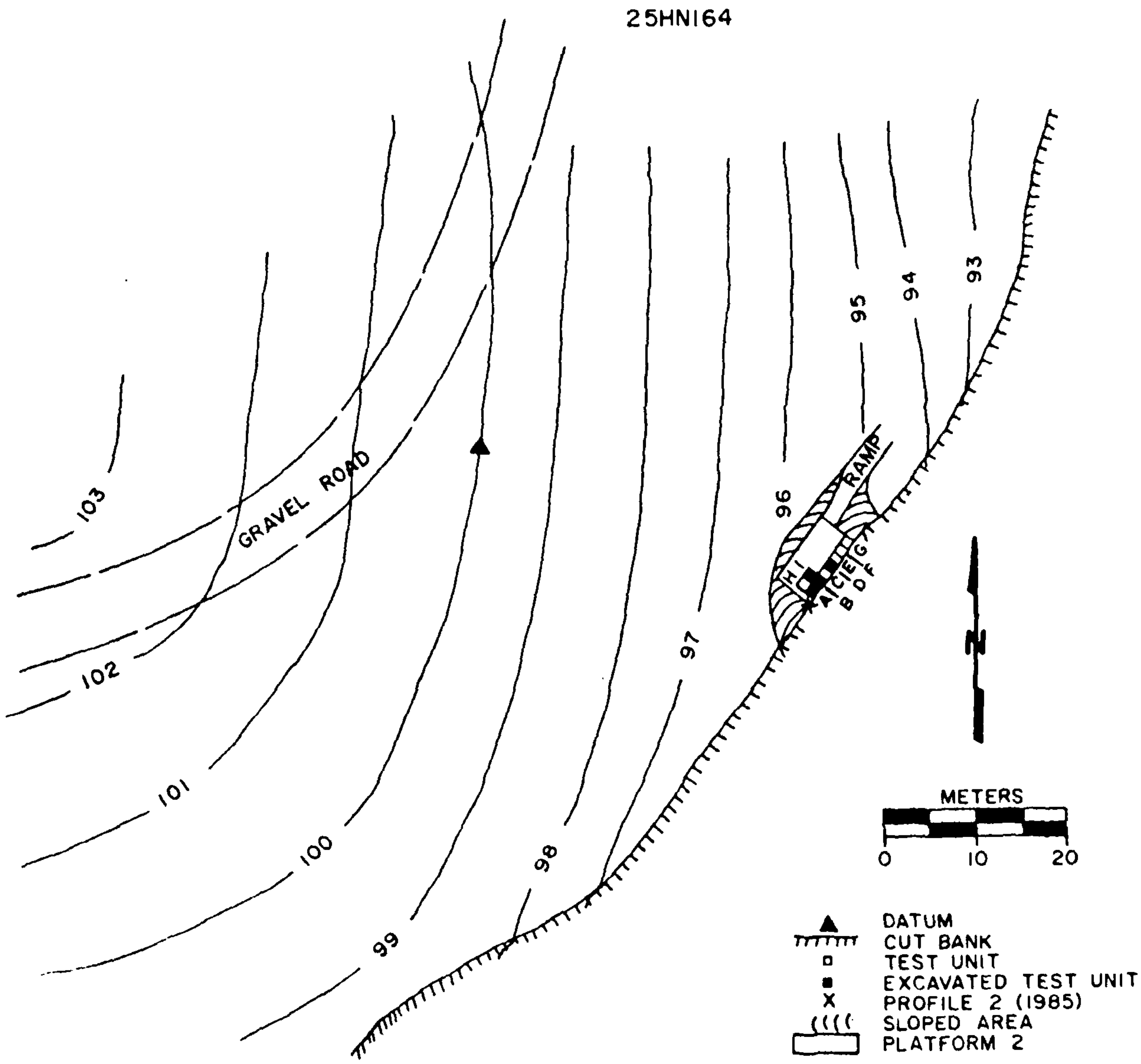
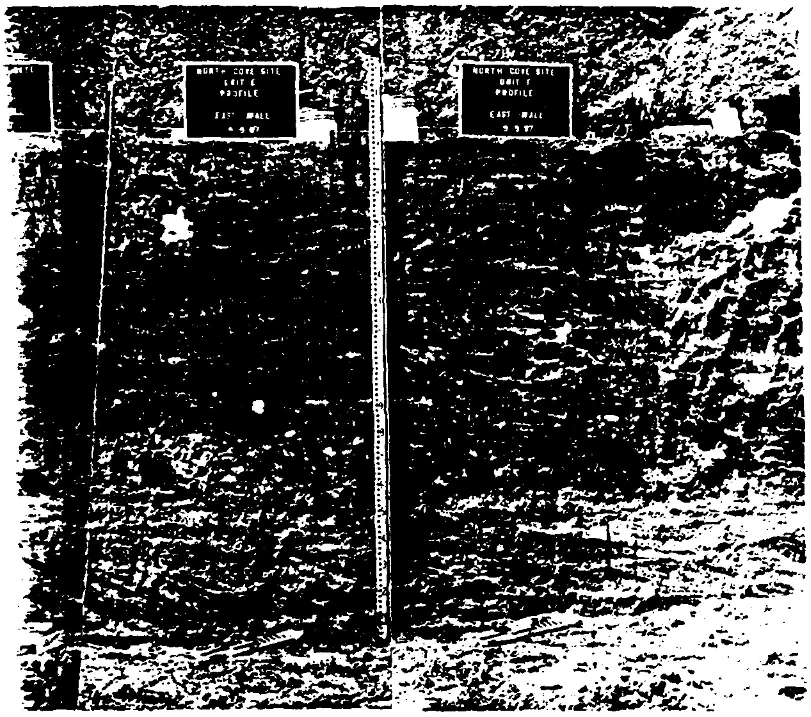


Figure 6. Plan view of North Cove site showing location of second platform and test units A-I.

Figure 7. Crew making stratigraphic profile of Test Units A-F. Note stakes indicating location of these units. View is to the southwest.

Figure 8. Photographic mosaic of the east profile of Test Units A-F. Compare with Figu



nits A-F. Compare with Figure 9.

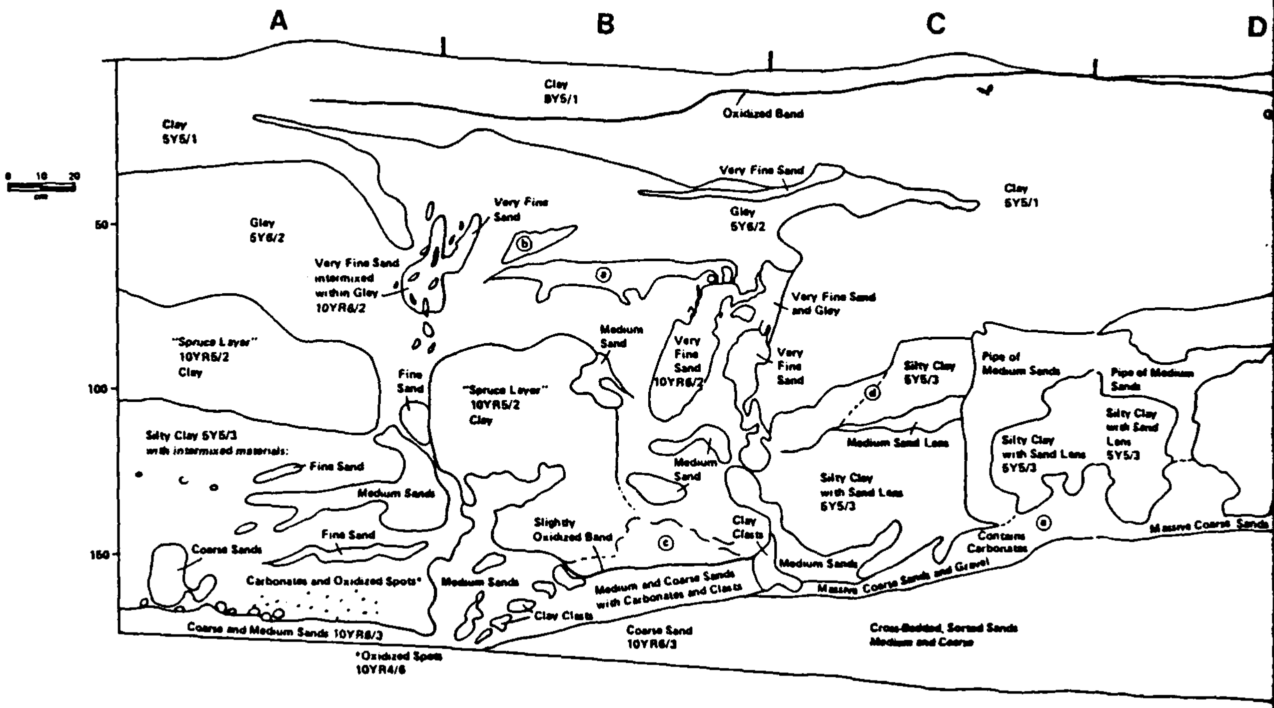
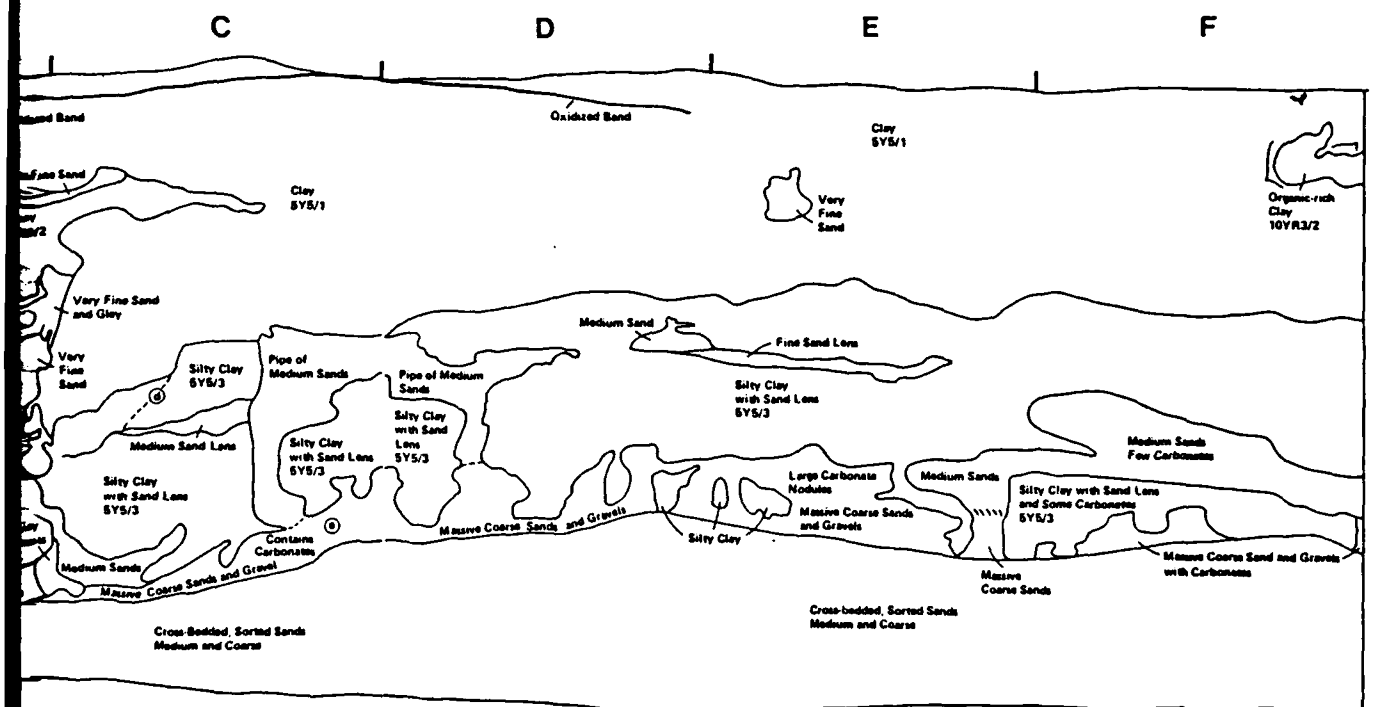


Figure 9. Stratigraphic profile of east wall of Test Units A-F. Units A, B and D were e
deposition: b) Angular clast ripped from a), non-convoluted, still horizontal laminati
approximately 3 cm; faulting and movement occurred after separation from a); c) Inter
sharp contact between spruce/clay and sands: d) Plane along which slump occurred. Mater
lens: e) Coarse sands and gravel sort out to medium sands within "bubbles."



f Test Units A-F. Units A, B and D were excavated. Key: a) Laminated fine sand, convoluted after
non-convoluted, still horizontal laminations unlike a); contains 3 normal faults with an offset of
rred after separation from a); c) Intermixed spruce/clay and lens of fine and medium sand. Not a
) Plane along which slump occurred. Material is same as lower material in Unit A; contains fine sand
edium sands within "bubbles."

sands, these three strata were distinguished and treated separately as well. All fill, with the exception of the basal sands, was water screened in the immediate site area with the flotation process. Samples of basal sands were water screened and in all cases found to be both paleontologically and archaeologically sterile.

Flotation devices used during the excavation are pictured in Figure 10a. This technique results in the separation of materials heavier than water, such as stone and dense bone, from those lighter than water, such as small bone fragments, snail shells, and charcoal. The former sink to the screened base of a large barrel within the flotation drum (Figure 10b) and the latter are caught by a geological sieve fixed to a spout on that barrel (Figure 11a). Both heavy and light fractions were dried on black plastic sheeting on the beach at the site. The fact that the beach is composed of Pierre Shale (Cretaceous age) and occurred safely beyond the Quaternary deposits of the bluff face precluded contamination of the fractions during the drying process. Figure 11b depicts an example of the abundant microfaunal remains retrieved with this technique. The value of flotation to the investigation of the North Cove site is underscored by fact that all artifacts recovered in 1987 consist of small flakes found in the flotation screens. None was large enough to have been noted during the excavation process. Dry screening would have been incredibly tedious, given the density of the Late Pleistocene sediments, and less likely to have resulted in recovery of some of the small flakes found during flotation (e.g., one artifact is smaller than 1/4 inch mesh hardware cloth). Moreover, such a method would have wreaked havoc on the delicate faunal remains.

Test Units A, B, and D were excavated as follows: Unit A was dug to a depth of 170 cm below unit datum (i.e., the southwest corner of that unit): Unit B was dug to depth of 180 cm; Unit D was dug to a depth of 140 cm. Two additional units were defined along a line west of and contiguous with units A and B. That west of Unit A was called Unit H and that west of Unit B was designated Unit I. The latter was excavated to a depth of 170 cm below its datum. Photographs (Figure 12) and detailed stratigraphic profiles of the west wall of each excavated unit were produced in order to document the westward rising gradient of the deposits. This gradient was also documented in the same fashion on the north walls of Units B and I (Figures 12-13). Sediment and pollen/opal phytolith samples were carefully collected from the south wall of Unit A for sedimentological and palynological analyses. Results of these studies are found in chapters three and four. In addition to the abundant faunal remains and smaller sample of floral material, a small sample of cultural material was recovered from the Late Pleistocene horizon. These artifacts, their stratigraphic provenience and attributes, are described in chapter six.

A

Figure 10a.

Flotation drums in use on the beach at the North Cove site; far drum shows how inner barrel can be removed for periodic inspection of heavy fraction.

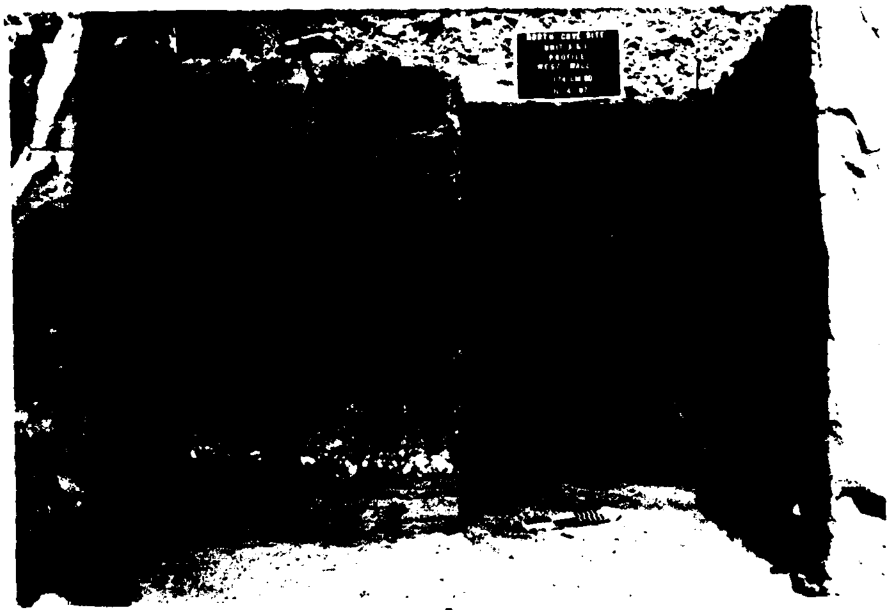
B

Figure 10b. View of typical heavy fraction. Larger materials are undissolved clays from the Late Pleistocene deposits.

A

B

Figure 11a. View of typical light fraction in sieve from flotation drum. Lighter materials are snails, darker materials are charcoal and bone, and the paper (waterproof) contains the provenience data.
Figure 11b. Sample of abundant microfaunal remains recovered by water screening Late Pleistocene deposits at the North Cove site.



A

B

Figure 12a. West profiles of Units A and I. Note the westerly rising gradient of strata demonstrated in this view by the vertical difference in basal sands capped by carbonate nodules. The horizontal difference between the west wall of Unit A and Unit I is one meter.
Figure 12b. North profiles of Units B and I showing westerly gradient of strata. Level string on wall of Unit B provides reference.

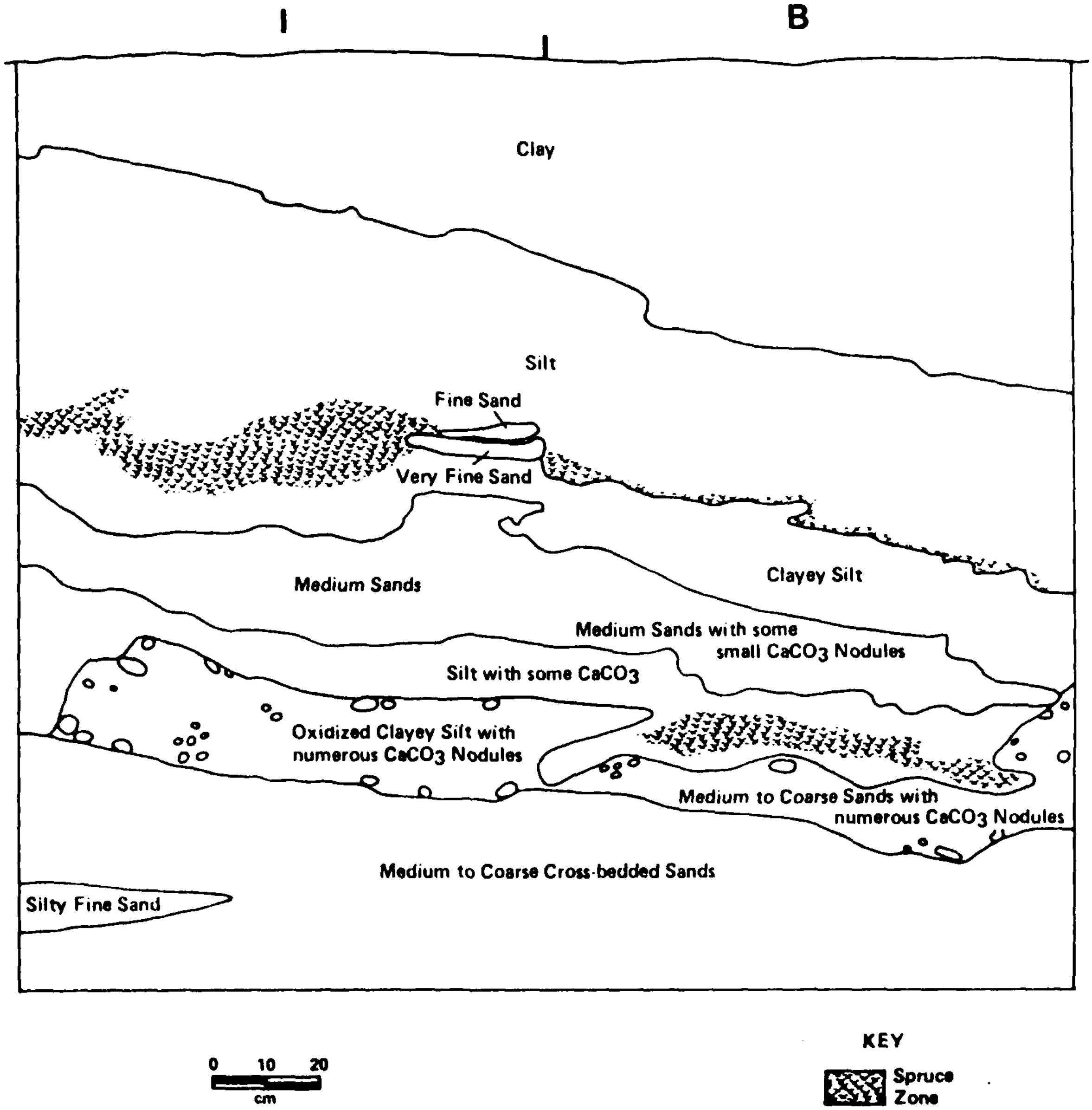


Figure 13. Stratigraphic profile of north wall of Units B and I. Compare with Figure 12b.

Chapter 3

Stratigraphy and Late-Quaternary Landscape Evolution

William C Johnson

General Site Description

The North Cove site is contained within an eroding face of North Cove on Harlan County Lake. As with all other such faces on the lake frontage, this one will continue to retreat while in contact with the lake (Fig. 14). Three processes are operating in produce this retreat. Undercutting of the face occurs at lower lake levels when the wave energy is dissipating as it runs up on the shale bedrock at the base of the exposure, resulting in collapse of the overhanging sediments. This is particularly effective because the relatively cohesive silts are underlain by fluvial sands which are easily eroded and transported through wave action. At moderate to high lake levels wave action is able to attack the higher portions of the exposure directly. Finally, when the water level is dropped after high levels in the spring and early summer, ground water flows out of the face resulting in slumping. Other processes such as basal sapping and freeze-thaw, although less significant, are likely contributing. Without human inducement of these processes at the site, it would likely never have been discovered, but is also fleeting as a result. Further, the presence of the backfilled excavation has accelerated erosion of the face somewhat. Considering the tremendous amount of paleoenvironmental data extracted from the site, however, the impact on the aesthetics and erodibility of the wave-cut face has been minimal; Figure 15 depicts the face prior to and after the excavation.

The site was first discovered because of its stratigraphically distinctive character: well-developed buried paleosols are visible from afar, and certainly close up (Fig. 16). It is unique because it consists of several types and ages of deposits in close proximity or direct contact with one another. Figure 17 provides a diagrammatic rendition for the entire exposure face. The basal element of the exposure is the Cretaceous-age Pierre shale. Overlying this is a one- to two-meter thick deposit of fluvial sands. On the south (left) end of the exposure, the fluvial deposit and shale have been truncated and subsequently replaced by loess. The oldest of two loess units present is an early (lower) Peoria loess, which was deposited from approximately 20,000 to 16,000 years ago. The former age is based upon the regional literature and the latter age upon a radiocarbon age of about 16,000 years ago (Table 1) from a paleosol developed in the early loess at its contact with the late (upper) loess, which contains late-Woodfordian (Tazewellian) snail

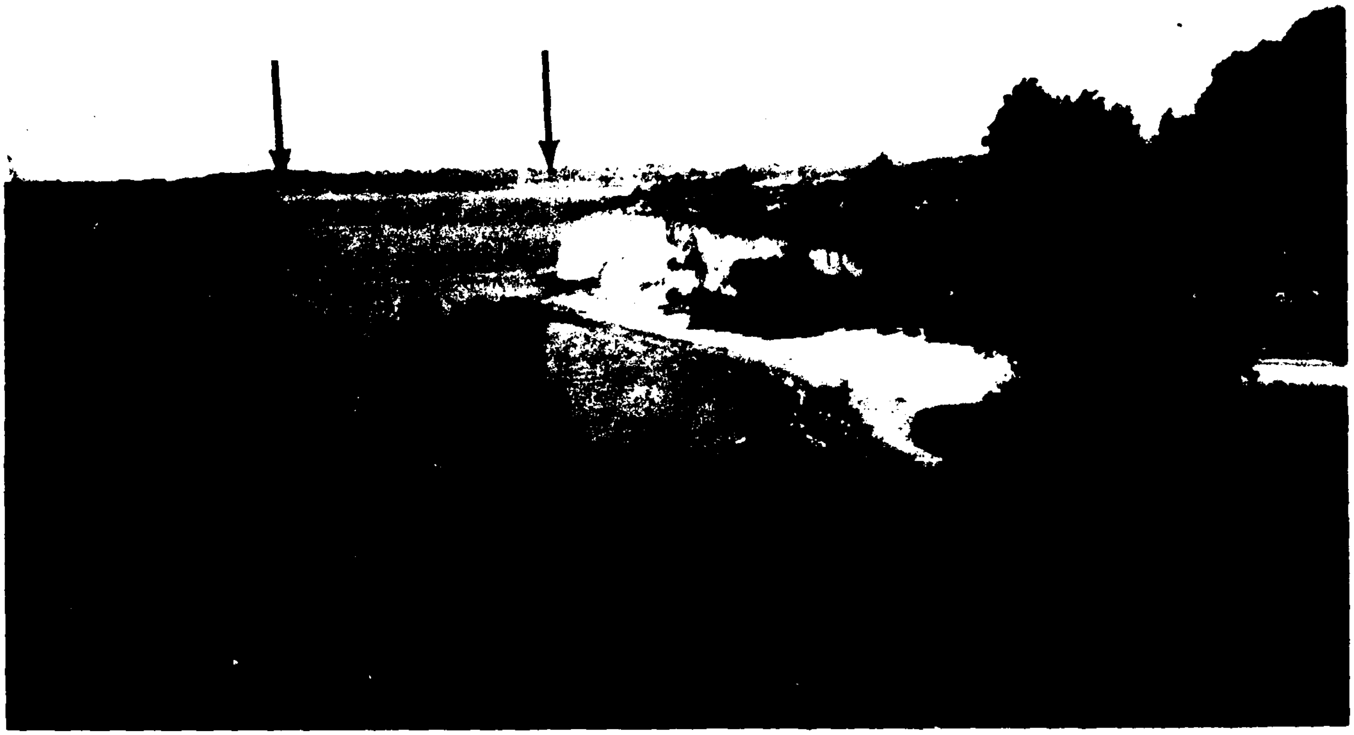
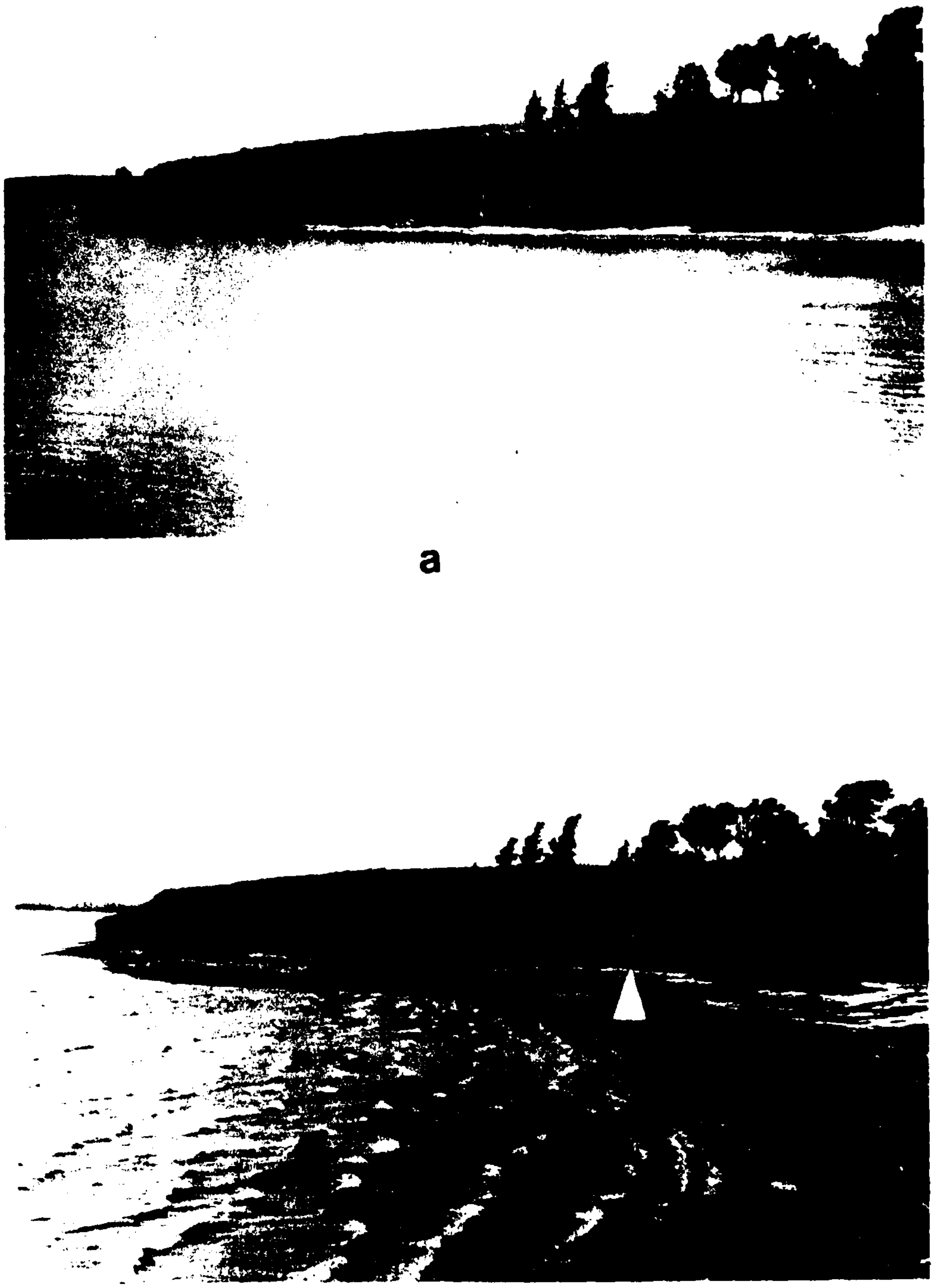


Figure 14. A view south across Harlan County Lake. The wave-cut face in the middle ground comprises the North Cove site. The faces are ubiquitous around the edge of the lake; two others are visible in this scene on the south side of the lake (arrows).



a

b

Figure 15. The North Cove site, on the west side of North Cove, as viewed from the east side of the cove: (a) the face in summer of 1985 when its paleoenvironmental potential was first realized, and (b) the face in fall of 1988 after the scar of the 1987 excavations had partially healed. An arrow in (b) indicates the excavation scar.

Figure 16. A low-water view of the face prior to the 1987 excavations. The letter "S" indicates the approximate location of the Woodfordian-age spring deposits excavated.

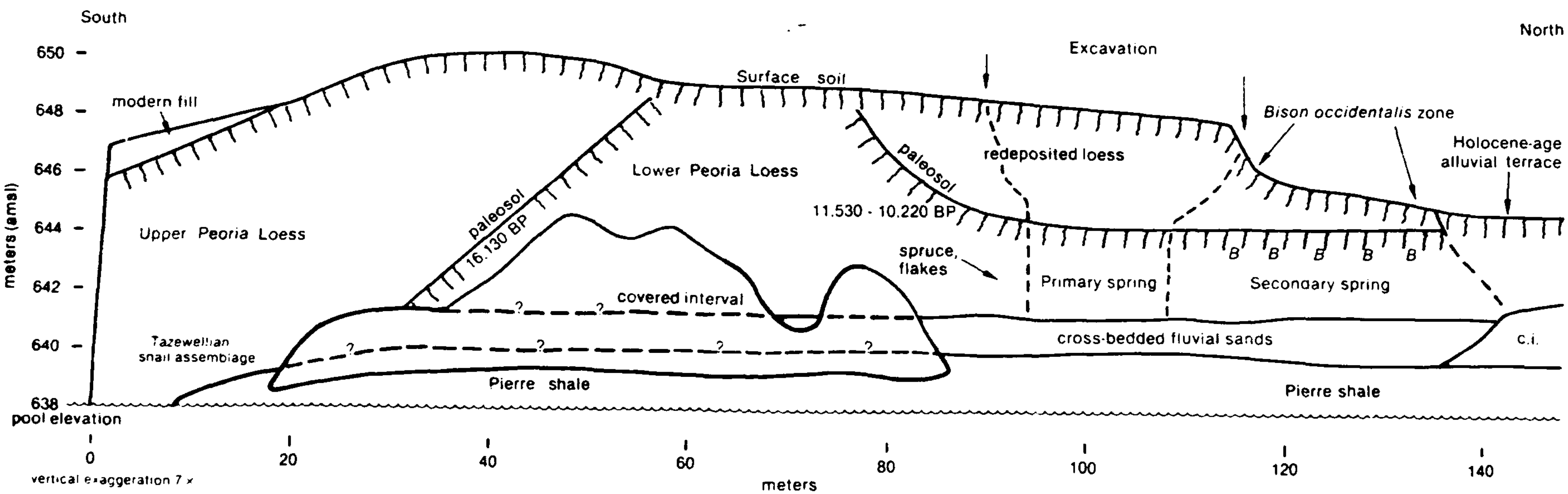


Figure 17. Schematic profile of the face comprising the North Cove site. The diagram indicates major stratigraphic components, e.g., faunal remains, buried soils (paleosols), spring deposits, and the spruce wood and flake zone.

TABLE 1

RADIOCARBON AGES DETERMINED FOR THE NORTH COVE SITE AND ELSEWHERE ON HARLAN COUNTY LAKE, NEBRASKA

North Cove site

Lab Number	Date in Years B P	Sample Type	Sample location or identification
DIC-3357	6860 ± 100	soil humates	paleosol
DIC-3358	16,130 ± 270	soil humates	paleosol
Beta-12,286	14,700 ± 100	*Picea* sp. wood	spruce zone
Beta-18,188	12,650 ± 250	wood	spruce zone
UGa-5474	10,120 ± 405*	bone	bison metapodial
UGa-5475	11,020 ± 635*	bone	bison vertebra
UGa-5476	12,965 ± 135*	wood	spruce zone
UGa-5477	13,100 ± 140*	wood	spruce zone
UGa-5480	11,365 ± 865*	bone	bison humerus
Tx-6110	12,620 ± 160*	humates	organic stratum
Tx-6112	10,220 ± 140*	soil humates	paleosol
Tx-6275	10,580 ± 2200	charcoal	spruce zone
Tx-6276	11,260 ± 2020	charcoal	spruce zone
Tx-6277	12,860 ± 1650	charcoal	spruce zone
Tx-6319	10,550 ± 160*	soil humates	paleosol
Tx-6320	10,270 ± 160*	soil humates	paleosol
Tx-6321	11,530 ± 150*	soil humates	paleosol

Other Harlan County Lake sites (C.W. Martin, in prep.)

DIC-3309	4870 ± 100	soil humates	paleosol (Alma Vista)
DIC-3310	10,140 +110/-120	soil humates	paleosol (Prairie Dog Bay)
Tx-5909	10,360 ± 130	soil humates	paleosol (Prairie Dog Bay)
Tx-5910	26,260 ± 680	soil humates	paleosol (Bone Cove)
Tx-5911	2020 ± 60	soil humates	paleosol (above lake)
Tx-5912	3050 ± 60	soil humates	paleosol (above lake)
Tx-5977	3720 ± 90*	soil humates	paleosol (above lake)
Tx-5978	2780 ± 80*	soil humates	paleosol (above lake)
Tx-5979	4550 ± 80*	soil humates	paleosol (Alma Vista)

*individual 13 C correction

fauna. The surface fill overlying the upper Peoria loess at the south end of the exposure is historical, relating to public-use area development and/or emplacement of buried gas lines.

An ancestral river channel shifted laterally cutting into the loess. Shortly therafter the channel was abandoned and vertical accretion of the site began. Spring deposits occur above the cross-bedded river sands in the abandoned channel. The deposits have been segregated on the basis of geomorphic, radiometric, and faunal data into distinct units. Water-lain and colluvial deposits overlie and interfinger with the spring deposits, which in turn are capped by a well-defined paleosol with radiocarbon ages averaging above 10,300 yr. B.P. Loess, largely colluvially redeposited, comprises the uppermost deposit. The northern (right) end of the exposure reveals that middle- to late-Holocene alluvial fill has been inset.

Site Stratigraphy

Composite stratigraphy. The excavation focused on the portion where the spring activity was best expressed. Although excavation faces and profiles have been well documented via field drawings and photography, an initial discussion of site stratigraphy is facilitated through the use of a composite schematic section rather than all or some of the specific profile data. The composite section (Fig. 18) exhibits all of the stratigraphic components in their appropriate positions. Also, refer to Table 2, which contains stratigraphic data for one of several measured and sampled sections along the length of the exposure face. It is representative in terms of stratigraphic units, their typical depth below surface, and physical attributes. Note particularly the dominance of the silt fraction, an indicator of a loess source material.

Four general stratigraphic units have been defined in order to emphasize the genetic differences and the evolutionary history of the site (Fig. 18). Unit I is the one-to-two meter thick layer of fluvial sands; Unit II, the spring conduit system and overlying, intruded deposits; Unit III, latest- Pleistocene or earliest-Holocene sediments capped by a major soil; and Unit IV, colluvially-derived Holocene-age sediments with the surface soil topping it.

The basal, eroded Pierre shale is overlain by one to two meters of cross-bedded river channel sands (Unit I; Fig 19). These sands contain silt and clay balls and lenses, as well as zones of iron and manganese oxides that have been concentrated at textural boundaries. The surface of the shale beneath the fluvial sands is unweathered, but at the south end of the exposure where loess overlies the shale, the

TABLE 2

GENERALIZED STRATIGRAPHY OF A REPRESENTATIVE VERTICAL SECTION AT THE NORTH COVE SITE

Depth (m. below surface)	Unit Description	Particle size(%) (sand)	(silt)	(clay)
0 - .75	surface soil; silt, 10YR2/1 (black)	10	69	21
3.20 - 3.48	silt: calcerous (incr.), 10YR3/2 (v. dark, grayish, brown)	8	71	21
3.48 - 3.63	silt: calcerous, 10YR3/3 (dk. brown)	7	71	22
3.63 - 4.50	Paleosol (upper A): 10YR2/2 (v. dk brown)	9	64	27
	(lower A-upper AB): 10YR4/1 (dk gray)	3	52	45
4.50 - 5.08	clayey silt: slight gleying, 2.5Y4/2 (dk. grayish brown)	6	66	28
5.08 - 5.22	laminated clayey silt: 10YR3/1 (v. dark gray)	2	64	34
5.22 - 5.60	clayey silt: slight gleying,2.5Y5/2 (grayish brown)	12	66	22
5.60 - 6.50	spring conduit sands: fossiferous,fine to medium grained	-	-	-
6.50 - 8.40	fluvial sands: crossed bedded, medium to coarse grained	-	-	-
8.40 +	Pierre shale	-	-	-

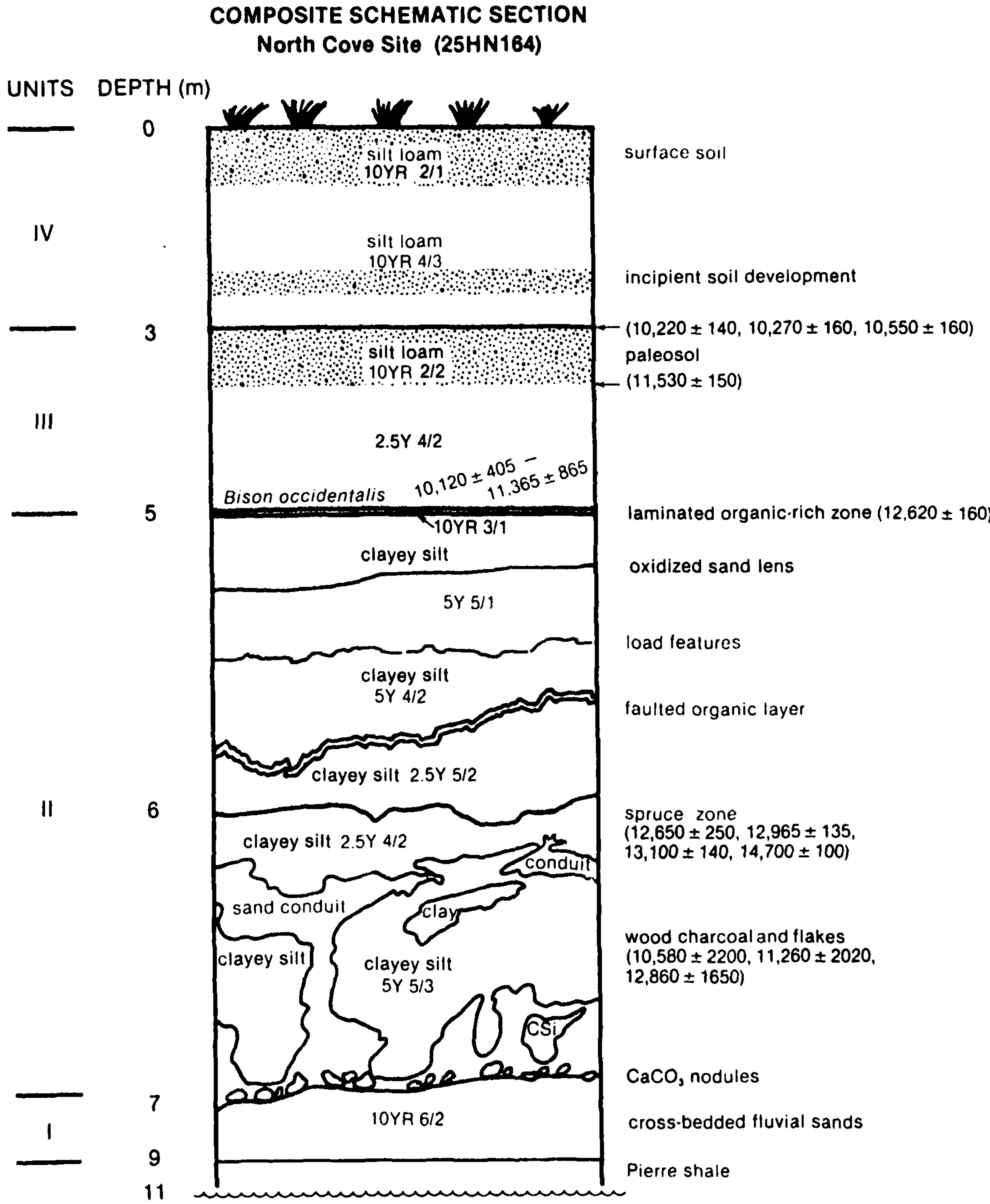


Figure 18. Composite schematic section of the North Cove site where excavated. This is not a profile of a given test unit face, but rather is a composite representing the typical stratigraphic assemblage. Note the variation in vertical scaling. All dates are years B.P.

Figure 19. Exposure of the cross-bedded fluvial sands situated between the Pierre shale below and the Woodfordian spring deposits above. The shale is not exposed, and an arrow designates the contact with the spring deposits.

latter is notably weathered (Fig. 20). Hydrostatic pressure of water in the sands above the shale aquiclude carried the finer fraction of the fluvial sand up into accumulating, overlying sediments, creating the spring deposits. The upper 5-15 cm of the fluvial sands have notably modified due to the loss of the medium- and fine-grained fractions.

Intrusion of water into the overlying clayey silt has produced a series of spring conduits, or sand feeders, the complexity of which is only fully appreciated in the third dimension provided by the excavation test pits (lower Unit II). The sand conduits or feeders are shown in plain view on one of the floor levels of Test Unit A (Fig. 21). The conduits, oriented both vertically and horizontally, were sufficiently disruptive as to destroy bedding and create rip clasts in the zone of disturbance. The direction of flow within the conduits is evident from the orientation of microfaunal bone material (Fig. 22), and the cross-sectional and longitudinal sorting of sand grains. Extensive development of calcium carbonate nodules, or concretions, occurred subsequent to the de-watering of the springs through a drop in water table. The source of the carbonate was the underlying sands and possibly the loess-derived sediments introduced into the spring basin. Carbonate-rich groundwater was moving through the system continually during the time of spring activity. Carbonate precipitation and concentration has occurred subsequent to the spring activity, as clearly evidenced by the encrustation of bones, root fragments, one of the chert flakes, and sand grains, and by the concentration of nodules at the base of the spring conduits, i.e., immediately above the underlying fluvial sands. The spring deposits are clearly of two generations, and can be differentiated on the basis of sedimentary, stratigraphic, areal extent, and faunal elements (cf. "South Spring" and "North Spring": Adair and Brown, 1987).

The clayey silt and silt overlying and disturbed by intrusion of the spring sands was derived from bank slumping, colluvial movement off the adjacent loessal slopes, and occasional floodwaters occupying the old channel. Sedimentation had occurred to about the six-meter level (Fig. 18) where the 'spruce zone' exists. This zone consists of dark clayey silt, rich in detrital organic material and botanical micro- and macrofossils, the most important of which is the spruce wood. The spruce zone provides exceptional paleoenvironmental information as noted Fredlund (this volume). For example, three small spruce tree limbs, or branches, were found oriented in similar fashion within this zone at about N 75 degrees E and dipping 0-13 degrees to the east. Radiocarbon ages of spruce wood collected from the zone range from 14,700 ± 100 to 12,650 ± 250 yr. B.P. (Table 1). The jasper-derived flakes, of apparent cultural origin, were deposited as part of slump or as colluvial sediments prior to or contemporaneous with deposition of the spruce zone.

Figure 20. The contact between the overlying upper, or late, Peoria loess and the underlying Pierre shale. This contact occurs at the south end of the face comprising the North Cove site (see Fig. 4). Tazewellian (latest-Pleistocene) faunal remains were found approximately one meter above the spade handle. Also, the shale immediately beneath the loess is weathered, indicating exposure prior to burial by the loess.

Figure 21. The lower portion of the spring deposits as exposed in a plan view of excavation level 17 in Test Pit A. The dark areas indicate rip clasts of the "spruce zone"; intervening areas are sands forming the spring conduit system.

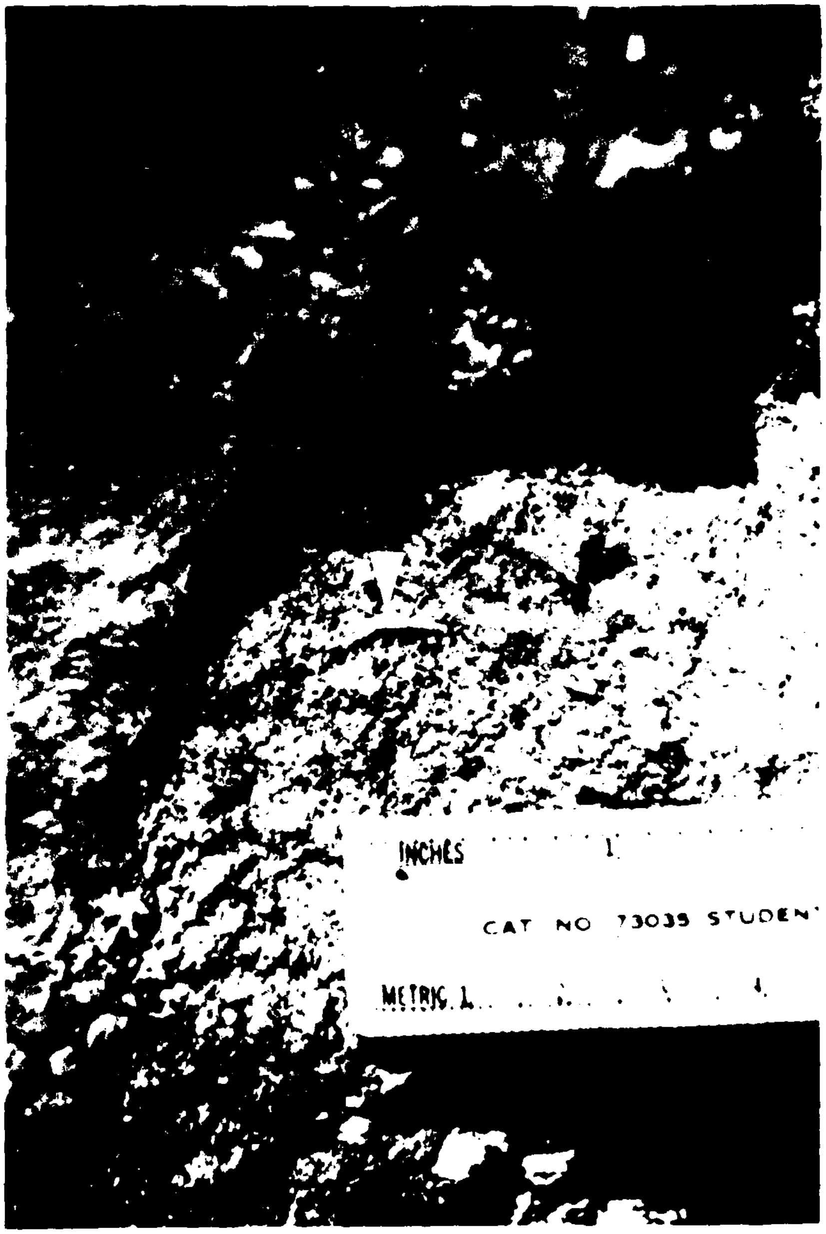


Figure 22. Close-up view of a sandy spring conduit, or feeder, containing a frog bone (arrow) oriented with the direction of water flow and sand movement. Vertebrate and invertebrate microfaunal material in the conduits is typically positioned as to indicate the direction of flow.

At approximately 5.8 meters below surface, there is a faulted organic stratum that was continuous across much of the excavation (Fig. 23). The layer originated from temporarily slowed sedimentation of the spring basin during which organic material could accumulate, presumably from floating aquatic plants and washed-in plant material. Renewed spring activity immediately below likely caused the disruption. Microseismic activity, which has been documented in the region, must not be dismissed. Similar faulted features have, however, been observed by this investigator within excavations of spring deposits elsewhere in Florida, Wisconsin, Missouri and Kansas.

Text-book examples of small load features are present along a stratigraphic boundary at about 5.5 meters below surface (Fig. 24). The clayey silt above and below this boundary was deposited in a semi-liquified state such that contact became fluid as the weight of the incoming clay sediment was distributed (e.g., Reineck and Singh, 1975). The feature has temporal significance because it approximates the level where the definitive Woodfordian indicator snails, such as Discus shimeki and Columella alticola begin to drop from the stratigraphic record. A thin lens of oxidized, very fine sand is more aerially extensive than either the faulted organic layer or the load features beneath. When dry, it is brittle from the cementation of grains by iron oxide. Woodfordian index fauna continue to decline until their complete replacement by Holocene-type fauna at about 20 cm above the oxidized sand lens.

A major stratigraphic feature is a 10-15 cm thick, organic-rich clayey silt stratum, laminated with intervening, thin, organic-poor silt layers (Fig. 25). This stratum is designated as the uppermost element of Unit II because it is the last stratigraphic indication of standing-water deposition. A radiocarbon age of 12,600 ± 160 yr. B.P. (Table 1) was determined from a sample taken in the zone. Extinct bison (B. occidentalis) bones, including a skull, ribs, podial, metapodial, and vertebrae have been found immediately above this zone, apparently resting upon it. One exception was a bison humerous found 15 cm below the stratum. Radiocarbon ages on the bone specimens range from 11,365 ± 865 to 10,120 ± 405 yr. B.P. (Table 1). Where the bones occur above the most recent (latest Pleistocene/ earliest Holocene) of two episodes of spring activity, sand conduits have, in some instances, perforated the laminated stratum and migrated along the bone surface. The sands contain aquatic material such as frog bones, snails, and an ostracode species unique to spring vents. The laminated layers are not pedogenic and appear to have been deposited in standing water. As implied above, this feature, unlike the strata below, is devoid of Woodfordian faunal remains.

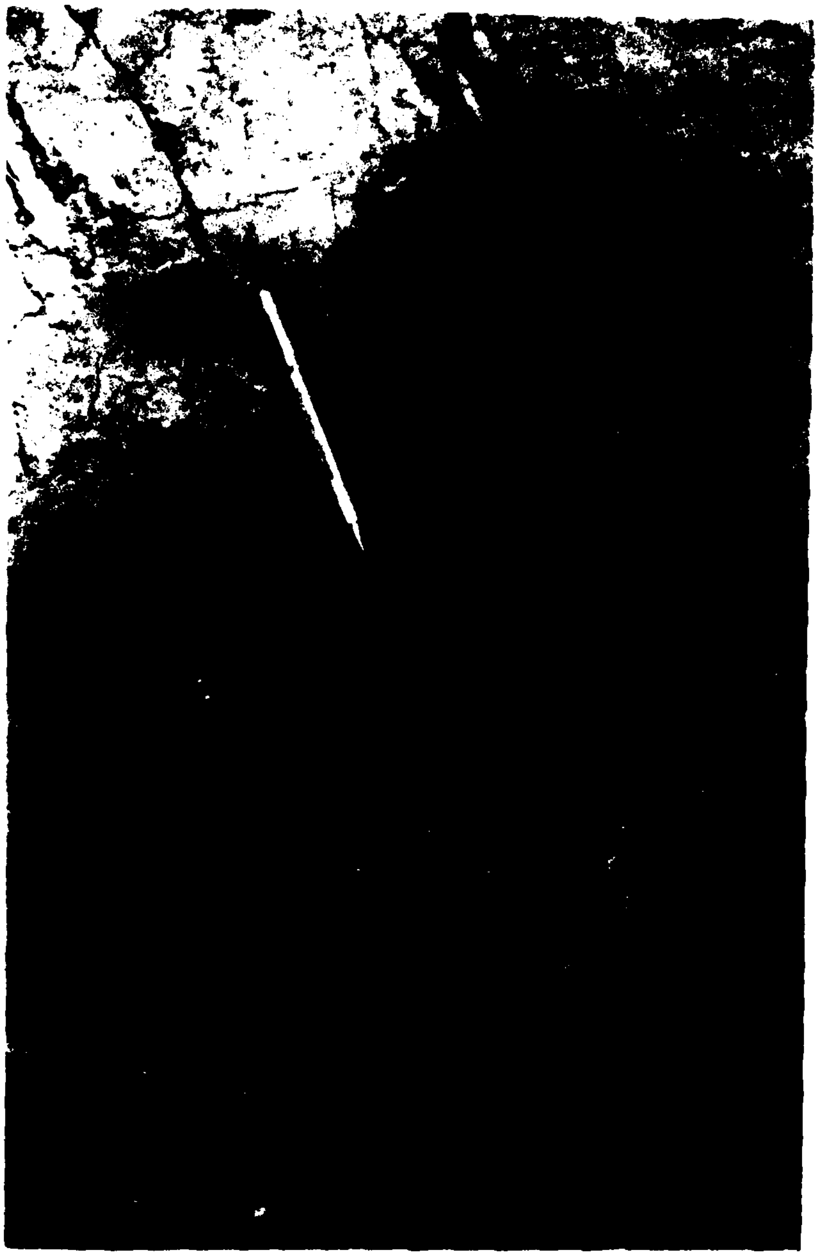


Figure 23. Faulted organic stratum within the upper portion of the Woodfordian-age spring deposits. The stratum, consisting of clayey silt approximately 20 cm above the spring deposits, was probably disrupted due to its proximity to the conduits. This is the uppermost stratigraphic element displaying disturbance by the underlying spring conduits.

Figure 24. Load structures on the upper contact of an organic-rich stratum, suggesting subaqueous deposition. Above this level Woodfordian fauna of boreal affinity begin to be replaced by those associated with the Holocene grassland and deciduous forest environment

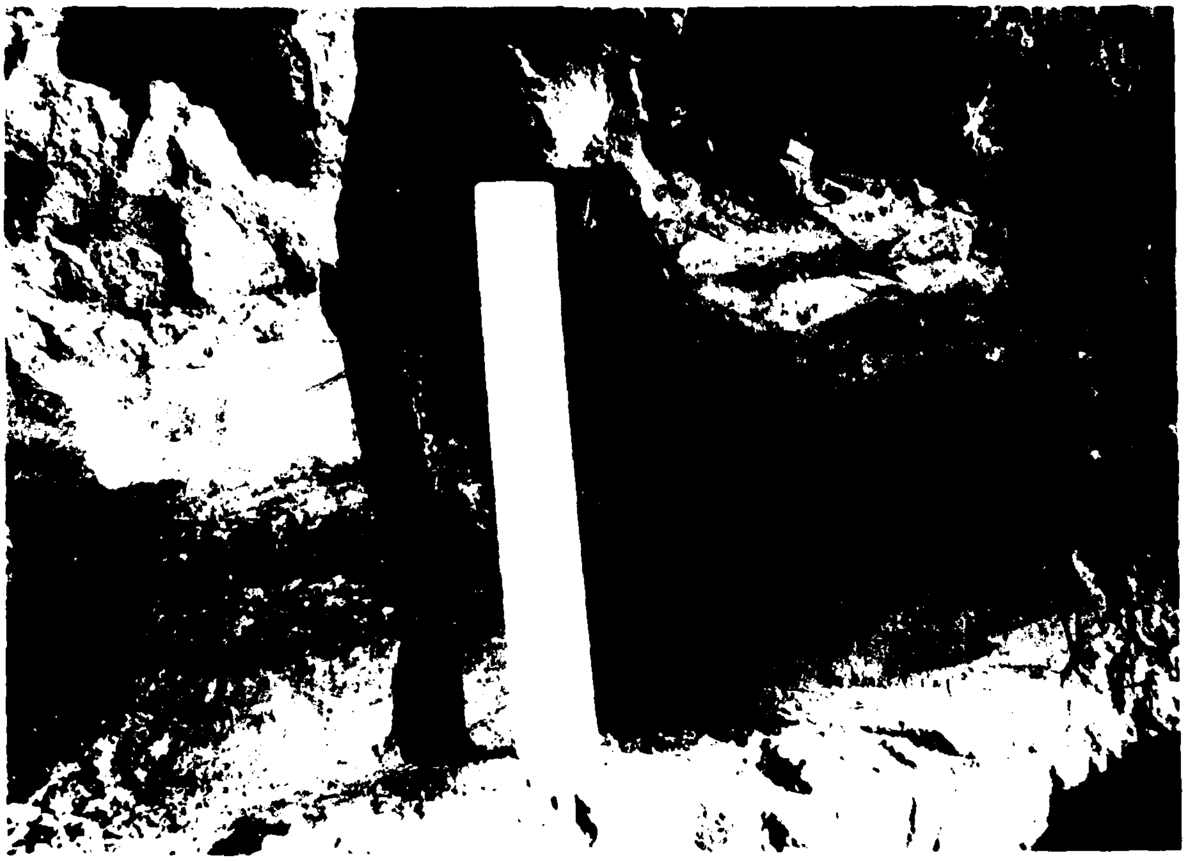


Figure 25. Laminated organic-rich strata at the top of Unit II, Figure 18. Bones of Bison occidentalis were common within and upon the feature. A radiocarbon age of 12,620 ± 160 yr. B.P. was obtained on humates from the strata. Three ages on associated bison bone samples were 10,120 ± 405, 11,020 ± 635, and 11,365 ± 865 yr. B.P.

Loess-derived silts surround and overlie the bison bone zone up to about three meters. The lowermost portion of the silt stratum, by the bison bones, is slightly gleyed (2.5Y), but becomes increasingly yellow-red (10YR) upward. The paleosol capping this unit has been radiocarbon dated from about 11,500 to 10,200 yr. B.P. This soil and the underlying bison bones and organic-rich stratum are obviously important time-stratigraphic markers for the site.

The Holocene, or last 10,000 years, is represented in the upper three meters of sediment. Although the surface soil is well-developed, there was a short period of landscape stability during which a weak soil developed briefly, at a depth of about 2 m.

Excavation stratigraphy. Actual stratigraphy exposed north-south along the clean east face, or profile, of the test units (A-F) at the excavation site clearly emphasizes the complexity and provides the anticipation for changes encountered in the third dimension (west) through excavation of the units. Figure 26, a modified version of Figure 9 (Chapter 2), shows the stratigraphy from the oxidized sand lens, or band, down to the fluvial sands (Units I & II). The relationships among the stratigraphy, radiocarbon ages, and jasper flakes is complex, but not unexpectedly so for a spring deposit (see Haynes, 1985).

The three radiocarbon ages of 13,100 $\pm$ 140, 12,965 $\pm$ 135, and 12,650 $\pm$ 250 yr. B.P. (Table 1) were determined from wood collected in the spruce zone. A fourth determination of 14,700 $\pm$ yr. B.P. was obtained from wood collected above the high-water in face slump immediately below the exposed spruce zone, i.e., it was not in situ. The remaining three radiocarbon assays, from wood charcoal collected within the spruce zone, are slightly younger overall and, because of small sample size, produced undersirably large sigma values (Table 1). The ages are in correct stratigraphic sequence, i.e., oldest to youngest upward; this may, however, be merely conincidental, again given the high sigma values. Ages determined from the wood are considered to be more reliable, or correct, than those from the charcoal.

Flakes were retrived from four separate levels in two different test units. Test Unit B produced one flake each at the 120-130 and 160-170 cm levels (below datum), and Test Unit D, one flake each in the adjacent levels of 120-130 and 130-140 cm. Since the dark-colored spruce zone and lighter non-spruce zone sediments were screened and washed separately for each 10-cm excavation level, it is known that the flakes were not within the distinctive spruce zone. It is also pertinent that the flakes were discovered below the levels dated at 10,580 and 11,260 yr. B.P., and, at least in one instance, below the 12,860 yr. B.P. level.

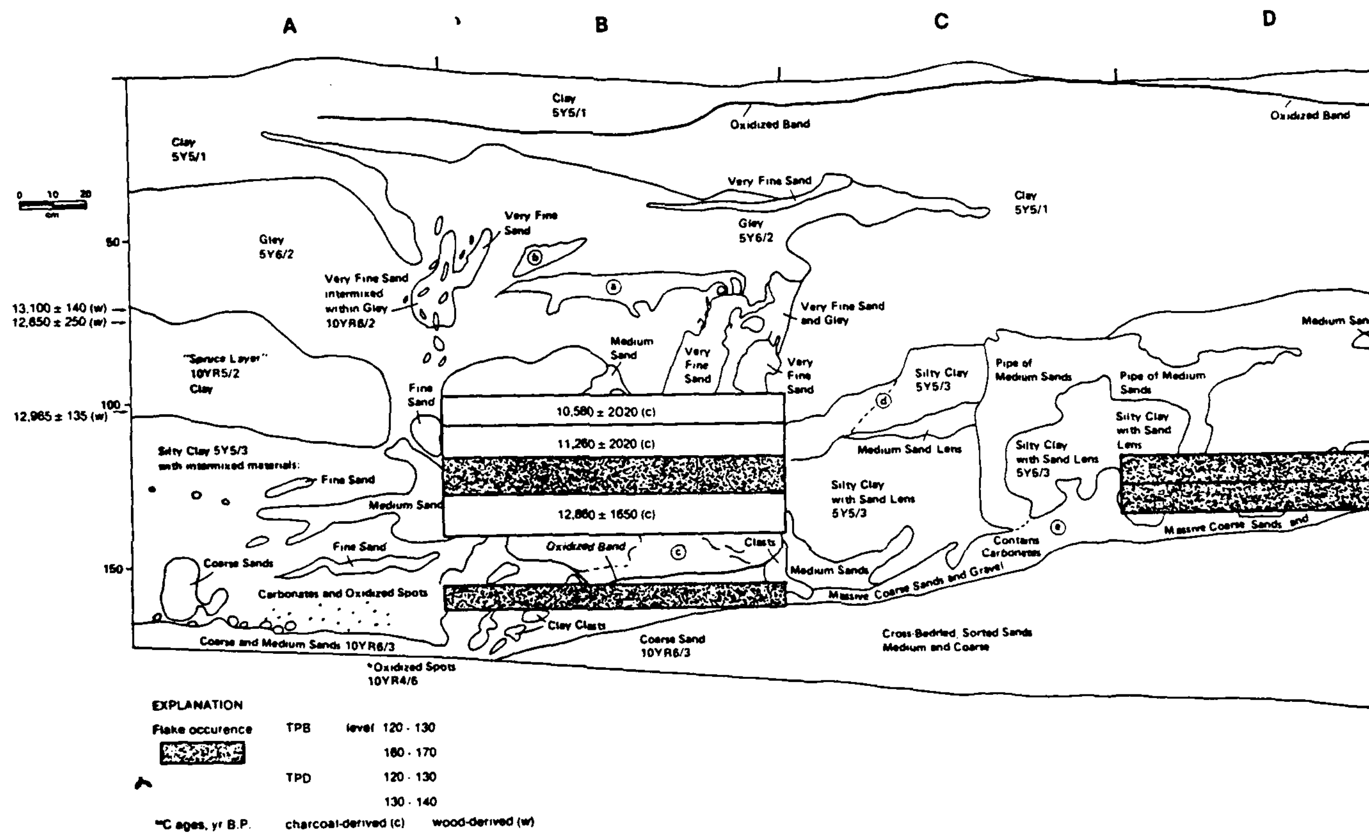
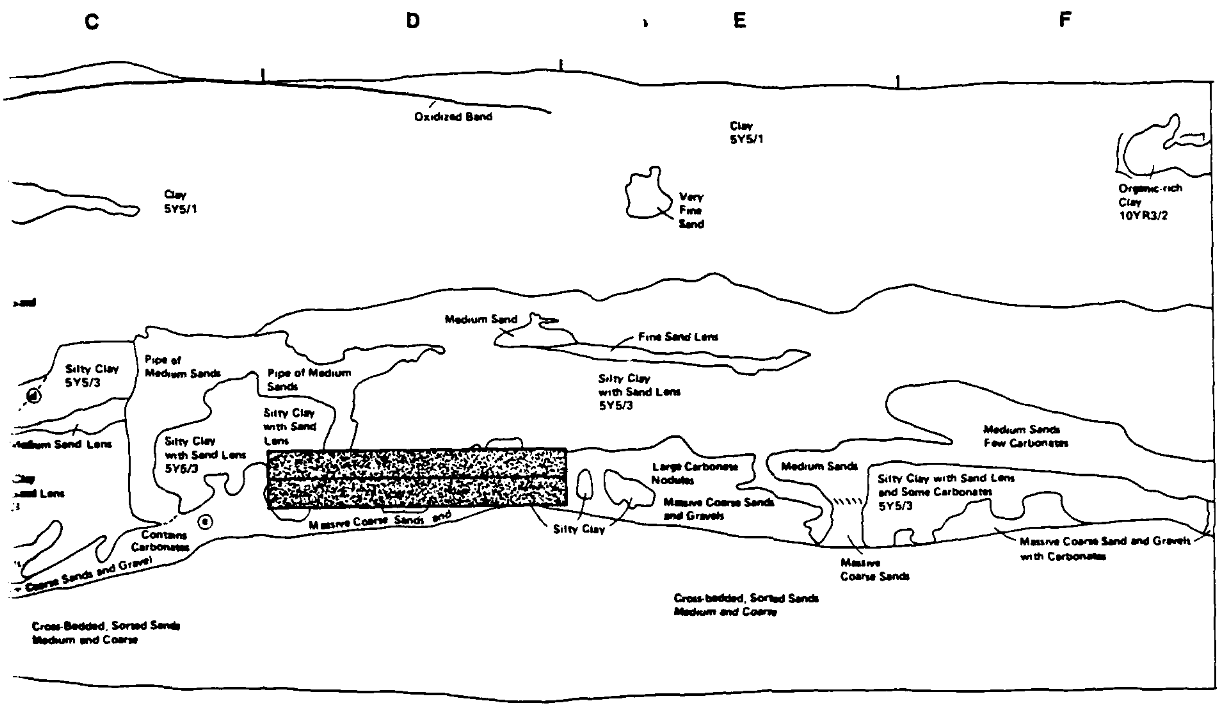


Figure 26. Stratigraphy exposed in the profile of the site, Test Pits A-F (e
flakes, and radiocarbon dated wood and charcoal from the spruce-bearing zone are
Figure 9 - Chapter 2 for the stratigraphic detail obscured by definition of the pe



profile of the site, Test Pits A-F (east faces), prior to excavation. The levels containing ırcoal from the spruce-bearing zone are identified to present the interrelationships. Reference detail obscured by definition of the pertinent levels.

Geomorphic History

The geomorphic history, or geologic sequence of landscape evolution, at the site is very interesting and more complex than other potential or demonstrated Paleoindian site reported thus far in the Great Plains. Consequently, there is sufficient data to provide a detailed description of the events occuring at the site over most of the last 20,000 years. A summary of the sequence of the events and their approximate absolute ages are presented in Table 3. The first event or feature recorded is that of a bed-load stream transporting sand across the Pierre shale. Orientation and magnitude of the sedimentary structures in the sands indicated a direction and depth of flow approximately S 30 degrees E, and one to two meters, respectively. The absolute age of the sands is unknown, but they are certainly post-Miocene based upon the presence of a magnum of horse (<u>Equus</u> sp.) and other perminineralized, broken and abraided bones, such as teeth and tusk. However, the sands are likely no older than Pleistocene and, due to the size of the river indicated, they probably represent an ancestral form of the Republican River. The ancestral river apparently meandered across much of the Harlan County Lake area, for fluvial sands outcrop above most exposures of the shale at this elevation. There are a number of good modern analogues for a sand-bed stream flowing on shale; the Arkansas River near Tulsa, Oklahoma, is probably a similar channel size analogue.

Loess deposition was the next event. Color, fauna contents, and mineralogy of the loess indicate it is the Peoria loess. One or more episodes of erosion removed some of the loess and truncated the fluvial sands and Pierre shale on the south (left) end of the exposure (Fig. 17). A soil subsequently formed on the early loess surface about 16,000 years ago as indicated by a radiocarbon age of 16,130 $\pm$ 270 yr. B.P. on soil humates from the upper 20 cm of the paleosol. During the late Pleistocene, i.e., after 16,000 years ago, the upper, or late, Peoria loess was deposited. Subsequently, the stream channel re-excavated the area by laterally cutting into the loess and depositing the channel-bed sands. It is known that the stream had occupied this location earlier because older, cross-bedded fluvial sands extend beneath the lower Peoria loess (Fig. 17). The result of the cutting was a relatively steep upward slope to the south and west. It was in the abandoned channel that the spring and an associated body of open water developed and persisted for several hundred of years. Limited drilling and exposures indicate the gradient on the shale aquiclude provided groundwater flow to this depressional exposure of the sands.

Silts and clayey silts were deposited on the sands via colluvial transport, perhaps through slumping, and occasional reoccupation of the channel by floodwaters. Sandy spring

TABLE 3

GEOMORPHIC HISTORY OF THE NORTH COVE SITE:
SEQUENCE OF MAJOR EVENTS

Approximate Age (yr. B.P.)	Event
Early-Mid Pleistocene	Sand-load stream system on Pierre shale
pre-16,000	Deposition of early (lower) Peoria loess
16,000	Soil formation on surface of early (lower) Peoria loess
16,000 - 10,000 (?)	Deposition of late (upper) Peoria loess Open, mixed spruce-deciduous parkland
14,000 (?) - 12,600	Lateral cutting and abandonment of river channel Vertical accretion of spring with floodwater deposits and redeposited loess Paleoindian activity (?)
12,600	Accumulation of laminated organic-rich sediments Bison (B. *occidentalis*) bones deposited
12,500 - 11,500 (?)	Renewed spring activity shifted several meters to north Further deposition
11,500 - 10,200	Slowed depostion and pedogenesis
10,200 - 2,000	Renewed deposition
5,000	Entrenchment of North Cove tributary Drop in water table and desiccation of spring
2,000 - 0	Development of modern surface soil
post A.D. 1950	Construction/closing of Harlan County Dam and erosion of wave-cut exposures

conduits, or feeders, began to penetrate the accumulating overlying sediments. Also, organic-rich sediments were depositing at the spring's edge. Paleobotanical data (Fredlund, this volume) indicate the presence of wet-spot species such as alder, sedge, cattail, and arrowhead. Spruce, birch, aspen, and other large aboreal species were growing on the adjacent surfaces. As noted above, four radiocarbon ages on the wood samples taken from the spruce zone range from 14,700±100 to 12,650±250 yr. B.P. (Table 1), and three wood charcoal samples dated 10,580±2200 to 12,860 ± 1650 yr. B.P. Although the spruce zone is disrupted, stratigraphically it appears to have been an organic layer at spring's edge that was broken up by subsequent sand injection from beneath, rather than falling or sliding into the spring as a slump block.

Filling of the spring depression with clayey silt continued at a sufficiently rapid rate as to preclude the accumulation of peat or thick organic-enriched layers. Only three stratigraphic features occur above the spruce zone: a thin faulted organic layer, another such layer exhibiting deformation from loading, and an oxidized lens of fine sand. The latter is notable because of its large aerial extent, apparent lack of deformation by the underlying spring vents, and influx of sand from above, rather than below, by wind or floodwaters. Overall, hydrostatic head and the nature of the overlying sediments limited disruption and mixing by sand convection to less than 1.5 meters above the fluvial sands.

Silt deposition continued in a water-saturated environment. Deposition, or accumulation, of the horizontal, laminated, and organic-rich sediments suggest short-term stability of the adjacent slopes and hydrologic regime. A radiocarbon ages of 12,620 ± 160 yr. B.P. was obtained on humates from a sample of the layer. A humerus from Bison _occidentalis_ found immediately below the layer dated at 11,365 ± 865 yr. B.P. A conncentration of _B. occidentalis_ was, however, found within and directly upon the layer. The density did not indicate a bone bed, but certainly the presence of bones from more than one individual. Also, no evidence of human working or butchering of the bones was noted. Bones discovered included ribs, podials, vertebra, a skull, a metapodial, and limb bone fragments. The vertrebra and metapodial dated at 11,020 ± 635 and 10,120 ± 405 yr. B.P., respectively. Fossil pollen and opal phytolith analyses of samples from the bison-bone layer and the overlying paleosol suggest vegetation at this time was comprised of highly diverse, warm season-adapted grasses, i.e., the Holocene grassland developed from the earlier boreal environment of the late-glacial period (Fredlund, 1987).

Spring activity resumed on a limited scale 10-15 meters north of the original spring site at a location up-gradient on the shale where the fluvial sand aquifer is higher. Cross-cutting relationships of the younger conduits are striking, as is the difference in the sand-grain size (smaller) and sorting (Fig. 27). As Stewart (this volume) notes, the invertebrate fauna of the more recent spring is latest Woodfordian or earliest Holocene, whereas the larger, older system contains exclusively Woodfordian fauna. The climatic amelioration is reflected in floral evidence also, both at the site (Fredlund, 1987, this volume) and regionally (Gruger, 1973; Fredlund and Jaumann, 1987).

As silt continued to accumulate, the surface became increasingly drier, although slight gleying indicates the sediments were perennially moist. Pedogenesis began about 11,500 yr. B.P. as sedimentation slowed dramatically. Cumulic A and B horizons developed until about 10,500 years ago. The lower 20 cm of the A horizon yielded a humate age of 11,530±150 yr. B.P., and the upper 10 cm, four separate ages of 10,220±140, 10,270±160, and 6860±100 yr. B.P. (Table 1). The upper A horizon was dated three times at the site, and once at an exposure of the soil on the east side of the cove (Fig. 28). The lower A horizon was dated only at the latter site. The radiocarbon age of 6860±100 yr. B.P. obtained from the upper A at the site is considered invalid because of its inconsistency with other assays and its high potential for contamination.

Renewed rapid sedimentation about 10,000 years ago buried the soil and continued at a sufficient rate to preclude significant soil formation until the present surface soil began forming. Silt which buried the early Holocene soil may have included Holocene-age loess as well as late-Pleistocene loess eroded from the adjacent slopes. When current surface stability began has not been determined, but regional soils-geomorphic data suggest about 2000 years ago. There is, however, structural and color evidence for an incipient soil at a depth of about 1.9 meters. Ongoing research by this investigator indicates the existence of loessal landscape stability around 6500 years ago sufficient for soil development; the faint soil may reflect that period of stability.

Entrenchment, alluviation, and re-entrenchment of the North Cove tributary occurred in response to larger scale, but similar, events in the adjacent Republican River valley. The terrace and underlying fill associated with the period of alluviation is inset into the late-Pleistocene and early-Holocene deposits of the site (Fig. 29). The original episode of entrenchment is dated at sometime around 5000 years ago, or earlier, based upon radiocarbon ages as old as 4870 ± 100 yr. B.P. on soils buried within terrace fill of the Republican River valley (Table 1; Martin, in prep.). The drop in water table associated with the entrenchment dewatered the spring deposits. Nodules and encrustations of

Figure 27. A profile in the area of the latest-Pleistocene/earliest-Holocene (post-Woodfordian) spring activity. The second period of spring activity is located 10-15 m north of the more extensive, earlier spring. Dr. J.D. Stewart is shown extracting a bison rib; he is standing on the carbonate-cemented spring deposits, which in turn overlie the cross-bedded fluvial sands.

a

b

Figure 28. Exposure of the 11-10,000 yr. B.P. soil on the east side of North Cove. The view in (a) is east across the cove from a location directly above the excavation; the arrow notes the location of the buried soil and where it was photographed in (b). As (b) shows, the A horizon, alone, of the soil is overthickened (cumulic); the arrows limit the horizon, and the field book provides scale. Radiocarbon ages of 11,530 ± 150 and 10,270 ± yr. B.P. were obtained on the lower and upper-most few cm of the A horizon, respectively.

Figure 29. Holocene-age alluvial fill inset into North Cove spring and associated deposits. The excavation is located by arrow A and the Holocene terrace by arrow B.

calcium carbonate formed in the spring deposit sands as a result (Fig. 30). The entrenchment and associated drop in water table may be related to the well-documented, mid-Holocene dry period in the central Great Plains (Johnson and Logan, in press). Intrinsic geomorphic controls (Schumm, 1973) and tectonics must not, however, be ruled out as at least potential triggering mechanisms for the event(s). Until the early 1950s, the site remained buried; closure of the dam and filling of the reservoir then began the process of wave-cut face formation, exposing the subsurface sediments.

Discussion

Radiocarbon ages. Although the radiocarbon chronology is sound, some inconsistencies exist among the ages. Comment on the variation in ages is crucial since jasper flakes, of probable human manufacture, were discovered in the lower portion of the section. Radiocarbon determinations from wood are generally accepted as the most reliable indicators of true age in radiocarbon years. As Figures 18 and 26, and Table 1 indicate, four ages were obtained on wood from the spruce zone, the oldest of which was not collected *in situ*. The remaining three ages of 12,650 ± 250, 12,965 ± 135, and 13,000 ± 100 yr. B.P. are all pre-Clovis, even minus one standard deviation. The three wood charcoal ages of 10,580 ± 2200, 11,260 ± 2020, and 12,860 ± 1650 yr. B.P. present a chronological problem: they range over 2000 years and have very large sigma values.

The next sequence of radiocarbon ages is adjacent to the laminated organic zone. Four ages come from that portion of the section. Three, ranging from 11,365 ± 865 to 10,120 ± 405 yr. B.P., are from bone. A fourth age of 12,620 ± 160 yr. B.P. comes from the base-insoluble fraction of the humates in the laminated zone. The difference between the humate and bone ages is probably due to the fact that dates obtained from bone (collagen/organic or apatite/inogranic components) are typically younger than wood or humate determinations. This is, however, not universally true and depends a great deal upon careful and appropriate attention to the pretreatment of the bone prior to dating (Taylor, 1987). Also, the base-insoluble humate fraction is considered by many laboratories and researchers to be the truest indicator of time elapsed. Recently intiated National Science Foundation-sponsored research by this investigator and Mr. C. W. Martin intends to resolve the question. Consequently, the 12,620 ± 160 yr. B.P. age is considered to be a truer indicator of radiocarbon years than are the ages on bone. Also, this age is consistent, stratigraphically, with the ages on wood samples below and the paleosol above.

Five radiocarbon ages were determined on samples collected from the latest-Pleistocene/earliest-Holocene

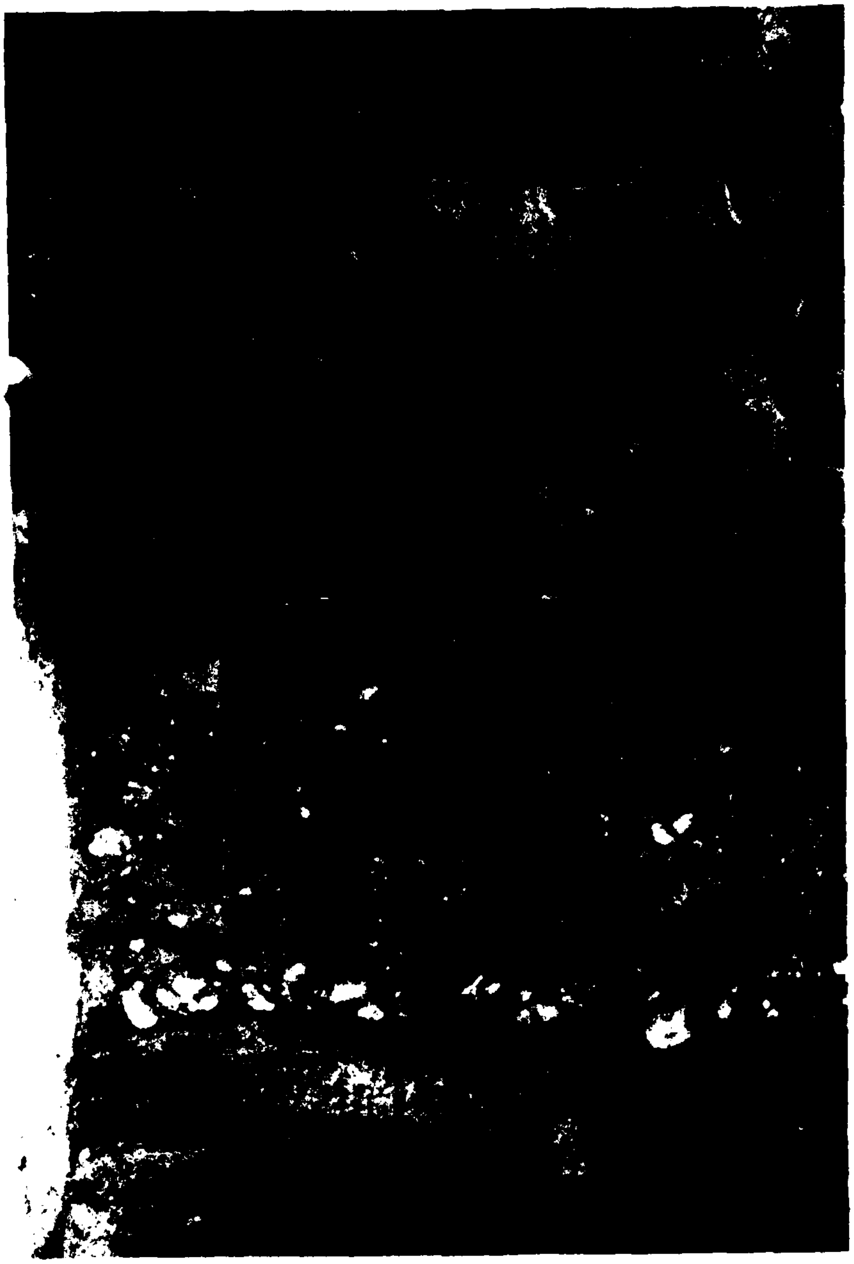


Figure 30. A zone of calcium carbonate nodules ("C") at the base of the Woodfordian spring deposits. Note the underlying fluvial sands and the overlying spruce zone deposits (trowel at latter contact).

paleosol A horizon. A first age of 6860 ± 100 yr. B.P. was obtained from the exposure face near the present-day surface. Contamination with modern carbon is probably the reason the age differs from those subsequent. The other three obtained from the upper A horizon vary only by 330 years and have similar, conservative sigma values. The oldest of the three, 10,550 ± 160 yr. B.P., was from a sample collected in the excavation proper, i.e., not from an existing exposure, whereas the most recent, 10,220 ± 140 yr. B.P., was from an existing exposure. As Haas and others (1986) point out, radiocarbon ages tend to be slightly younger when samples for assay are obtained from a weathered face, despite efforts to 'freshen' it by cutting back a few centimenters.

Absolute age control, from radiocarbon dating, appears to have served well at the North Cove site. A relatively detailed reconstruction of the geomorphic history is made possible, and a pre-Clovis age of the jasper flakes is demonstrated.

Regional correlations. The geomorphic history of the site agrees well with regional reconstruction of events. It is well documented that the Peoria loess was deposited in this region between about 20,000 and 10,000 years ago (Dreezen, 1970). Radiocarbon ages from the upper portion of the Gilman Canyon formation, a silt unit underlying the Peoria loess, average about 24,000 yr. B.P. (Dreezen, 1970; May and Souders, 1988; W.C. Johnson, unpub. data). Further, ages from the basal portion of Peoria loess fall about 20,000 yr. B.P. For example, an age of 19,640 ± 235 yr. B.P. (DIC-3118) was obtained by L.D. Martin and this investigator on spruce charcoal in basal Peoria loess (immediately above the Gilman Canyon formation) exposed near Central City, Nebraska, northeast of the study area. Thus far there is no indication elsewhere of a mid-Peoria loess paleosol, i.e. around 16,000 yr. B.P. The radiocarbon age from the site seems to be viable, however, given the recognition of Leonard's (1951) Tazewellian faunal zone (ca. 14,000 yr. B.P.) in the loess deposited above the soil, and the radiocarbon ages from the excavated section.

Peoria loess is occasionally capped by a buried soil, the Brady paleosol (Schultz and Stout, 1948), that dates 11-10,000 years ago (Frye et al., 1968; Dreezen 1970). The 11-10,000 year old soil is a primary stratigraphic feature at the North Cove site and adjacent exposures, as well as elsewhere around Harlan County Lake (Martin, in prep.; Table 1). Paleosols of this age are not limited to the loessal stratigraphic record. A very well developed soil, widespread throughout the Kansas River basin and others in the region, occurs within alluvial fills (Johnson and Martin, 1987). The implication is that regional stability was prevailing both upon the loess-mantled uplands and with the valley bottoms.

The soils are typically cumulic in nature, i.e., they have an overthickened A horizon, and exhibit a well-developed textural B horizon; this implies a soil development period of 1000 years or more. The regional and landscape-wide nature of the event indicates major climatic forcing.

Overlying Holocene-age loess, designated as the Bignell loess (Schultz and Stout, 1945), is elusive since the Brady soil must be recognizable in order to define presence of the former. It is probable that the Bignell is Peoria loess which has become re-entrained by the wind and subsequently deposited. This, in conjunction with post-depositional erosion, may explain the thin and discontinuous nature of the loess unit. Accordingly, some of the loess overlying the site may in fact be Bignell loess.

Middle- and particularly late-Holocene entrenchment, as occured in the North Cove tributary, is also very well-documented regionally (Johnson and Martin, 1987). A major period of entrenchment occurred around 5000 years ago in the Kansas River basin, which is why the event at North Cove is assigned to that time period. It may have occurred as late as 1200 years ago, but that seems to be too recent given the extent of Holocene terrace development within the North Cove tributary.

The prehistoric cultural context. Geomorphic, floral (Fredlund, this volume), and faunal (Stewart, this volume) evidence indicate the North Cove site provided a water source and other desirable cultural resources during the Paleoindian period. The affinity for water and their associated resources is well documented for Paleoindian (and Archaic, etc.) sites in the region, e.g., the Shriver, Selby-Dutton, and Lamb Spring sites.

The North Cove site provides the archaeologist and geomorphologist alike with a good example of an archaeological site that once was, but is no longer. The evidence for the site is found in a secondary context, i.e., presumably downslope from its original location, but stratigraphically sealed in sediments of a Woodfordian-age (late-Pleistocene) spring. We are once again reminded about the occurence of Paleoindian sites: they are frequently deeply buried (e.g., Lime Creek, Allen, and Red Smoke sites, Nebraska) or eroded, leaving only indirect evidence of their former existence. This site is unique in that it gives an appreciation of the potential for landscape change during and since the Paleoindian period. If one considers the time from the earliest spruce wood age (14,700 ± 100 yr. B.P.) to the beginning of soil development (11,530 ± 150 yr. B.P.) at the Pleistocene/Holocene transition, only about 3000 years transpired.

Chapter 4

PALEOVEGETATIONAL RECONSTRUCTION AT THE NORTH COVE SITE

Glen G Fredlund

Introduction

Although some of the most important Paleo-Indian sites in North America have come from the Central Great Plains there is relatively little concrete evidence regarding late-Pleistocene and early-Holocene environments of the region. This scarcity of regional data makes the North Cove Site important for both archaeology and Quaternary studies. At the North Cove site organic-rich sediments, probably the result of spring deposition during the late Wisconsinan, contain well-preserved pollen and macrofossil evidence of local vegetation. Unfortunately, except for the water-logged spring deposits themselves, pollen preservation was poor. Rather than a complete pollen and botanical macrofossil record of the late Pleistocene-early Holocene period, the North Cove spring deposit record probably represents a composite of the late-Wisconsinan (ca. 14,500 to 12,500 B.P.) local vegetation. There is some evidence for human presence at the North Cove springs during that late-Pleistocene period. It is the objective of this chapter to document the local late-Pleistocene vegetation at the North Cove springs and identify specific plant resources available to late-Pleistocene hunters-gatherers.

Regional Paleoenvironmental Overview

Precious little direct evidence exists for full-glacial Wisconsinan vegetation in the Central Great Plains and the interpretation of these sparse data can differ greatly. At one extreme the full-glacial vegetation has been characterized as a treeless arid steppe-tundra, while the opposite view characterizes the vegetation as boreal aspen-spruce parkland. The former of these interpretations is based primarily on the results of climatic modeling and verified by geomorphic evidence (Kutzbach and Wright 1986). The latter view is based on a few localities of documented spruce (including North Cove) and extrapolated regionally based on the widespread occurrence of boreal snails (Wells and Stewart 1985). There are problems with both of these extremes. Not surprisingly, the truth probably lies somewhere in between (Fredlund and Jaumann 1987). Most of the evidence for spruce-aspen parkland postdates the glacial maximum (ca. 18000 B.P.). Furthermore, these spruce sites all occur along larger river valley or escarpments.

It is hypothesized that boreal aspen-spruce parklands migrated across the Central Great Plains after the glacial maximum. Evidence for these open forests, perhaps just as correctly referred to as "boreal grasslands" (Rhodes 1984), occurs at a number of sites. Along the Arkansas river near Wichita, pollen and macrofossil evidence for this vegetation has been dated at ca. 19,000 B.P. (Fredlund and Jaumann 1987). At the Courtland Canal site in north central Kansas charcoal and pollen evidence date to around 14,500 B.P. (Wells and Stewart 1985). North Cove, just upstream along the Republican River from the Courtland Kansas site, dates to ca. 13,500 B.P. (Wells and Stewart 1985; Fredlund and Jaumann 1987). Further north, in south central South Dakota, evidence for spruce does not occur until 12,600 B.P. at the Rose Bud Site. (Watts and Wright 1966). The northward migration of boreal vegetation suggested by these sites is reinforced by chronology of sites in the northern Great Plains as well (Barnosky and Grimm 1987).

The composition of the late-Pleistocene Great Plains vegetation differs from modern boreal composition in several important ways. First, unlike the modern boreal forest, it lacks pine. Although there is some evidence for jack pine (Pinus banksiana) in the Ozark during this period, all pollen evidence from the Great Plains suggest that in the Great Plains proper, these pines existed as very small, isolated populations if they existed at all. A second common feature of the pollen assemblages is the presence of low (ca. 15%) but consistent relative frequencies of deciduous trees including aspen (Populus), Oak (Quercus), hornbeam (Carpinus or Ostrya), hazel (Corylus), willow (Salix), alder (Alnus), and birch (Betula). This suggests that these taxa were included in the vegetation and that there was far greater overlap of the ranges of these taxa and spruce (Picea engelmannii) than there is today. Data also suggest that the vegetation was more open than the typical boreal forest today (Wright 1970; Fredlund and Jaumann 1986). What is not clear is the vegetational structure. These elements could be arranged either in an open parkland or as a mosaic of spruce, deciduous, and prairie components.

Problems and Assumptions in the Interpretation of The North Cove Pollen

One of the problems of interpreting Pleistocene pollen records in the Great Plains is the variety of depositional environments which have yielded preserved pollen (Fredlund and Jaumann 1986). In an ideal situation regional pollen records are obtained from medium sized, open lakes (Jacobson and Bradshaw 1981). In the unglaciated Central Great Plains, where such small open lakes are rare, any site with potential for good preservation must be investigated. These include depostional situations including alluvial swamps, marshes, bogs, and springs. Such depositional environments differ greatly in their sensitivity to local, extra-local, and regional vegetational signals (Jacobson and Bradshaw 1981). We lack the modern analog studies to understand such site-specific depositional variability; but because data is so sparse, synthesis of regional vegetation often treat the few available records on par with lake records. This assumption is probably not warranted. These records, including the North Cove spring deposits, should be assumed as representative of local vegetation only.

A second potential problem in the interpretation of North Cove pollen is pollen preservation. Because post-depositional, deterioration of pollen can lead to differential preservation of differing pollen taxa (Hall 1981), proper reconstruction of vegetation from pollen assemblages on any scale assumes that significant pollen deterioration has not occurred (Delcourt and Delcourt 1980). At North Cove there is a very narrow window of good pollen preservation. Only those samples from the waterlogged spruce zone contained abundant, well preserved pollen. The interpretation and vegetational reconstruction will emphasize the samples from this zone.

Investigation of North Cove Samples

Eighteen sediment samples from North Cove have been analyzed for botanical microfossils. Eleven of these were reported in the original investigation. Out of the dozens of samples taken during the last field season, eight additional samples were selected for analysis this year. They were selected on two criteria: potential for pollen preservation and their stratigraphic proximity to the artifacts recovered. Five of these samples came from "Profile 1": (5) 4.10-4.15, (7) 3.90-3.95, (8) 3.75- 3.80, (9) 3.25-3.30, and (10) 2.95-3.00. One sample, depth 78 to 84 cm, was selected from "Unit A", South Profile (SW Corner). The final sample was "Test Pit I", North Face, (5) 0.63-0.78 cm.

Preservation of pollen was less than ideal in all of these samples. All but three samples (Profile 1 (5), Unit A 78-84 cm, and TPI 0.63-0.78) were totally barren of pollen. Even in these three samples, pollen concentrations were very low and preservation poor. The results from these samples were quite similar to samples previously investigated which had less than ideal preservation. It was decided that a re-examination of the samples of well preserved pollen from the spruce lens itself would provide better evidence for the paleoenvironmental setting of North Cove. In addition, botanical macrofossils were examined from two of these spruce lens samples.

Laboratory Methods

A modified heavy-liquid flotation procedure was employed in the concentration of pollen and phytoliths from these subsamples (Johnson and Fredlund, 1985; Fredlund, 1986). This procedure consists of five steps: (1) dispersal in sodium pyrophosphate (0.1 molar solution) and decantation of soluble organics, colloidal organics, and clays; (2) removal of carbonates with hydrochloric acid; (3) heavy-liquid fractionation of pollen and other silt-size organic particles from the clastic mineral fraction in zinc bromide (specific gravity up to 2.05); (4) alcohol (Butanol) dehydration of light, pollen-bearing fractions; and (5) storage in silicon fluid (viscosity 2000 c.s., refractive index about 1.45). Two permanently mounted slides for each of the residues were systematically searched using a Leitz photomicroscope. Estimates of pollen concentration were calculated by introducing a known number of exotic spores into each sample during the initial stage of pollen extraction. The ratio of counted spores to introduced spores can then be used to estimate the total number of native pollen grains and spores recovered (Benninghoff, 1962).

Botanical macrofossil were separated from the sediment matrix with a 0.1 molar solution of sodium pyrophosphate which acts both as a clay dispersant and mild oxidizing agent. The desegregated macrofossils were washed onto a 355 micron mesh sieve and allowed to air dry. The dried plant materials were sorted out under 20X magnification, with up to 70X magnification used to identify plant materials.

The Pollen Data

The palynological results of the re-examination of the three spruce lens samples were fairly consistent. Relative frequencies of total arboreal pollen (AP) and non-arboreal pollen (NAP) were about evenly split in all samples. Estimates of concentrations did vary significantly, but this was probably due to the large amount of wood and charcoal included in the processed portion of sample 1. All Quaternary grains which were damaged or hidden so that they could not be identified are listed as "Indeterminable" in Table 4. The most common reasons for Quaternary pollen being unidentifiable were chemical deterioration and mechanical breakage. Pre-Quaternary pollen and spores were present in all samples analyzed in low frequencies.

Table 4

Summary of palynological analysis from spruce lens samples, North Cove. Counts and presents for total Arboreal Pollen (AP), total Non-Arboreal Pollen (NAP), total Identifiable Quaternary Pollen, Total Indeterminable Quaternary Pollen, and Total Pre-Quaternary pollen and spores. Estimates of Quaternary pollen concentrations given in grains per gram sediment.

	Sample 1		Sample 2		Sample 3	
	#	%	#	%	#	%
AP	189	64.7	238	49.0	255	60.0
NAP	103	35.3	248	51.0	170	40.0
Total Quaternary	292	100.0	486	100.0	425	100.0
Concentration	1825		2432		7444	
Identified	292	83.5	486	84.6	425	86.4
Indeterminable	54	15.4	75	13.0	51	10.4
Pre-Quaternary	4	1.1	14	2.4	16	3.2
Total	350	100.0	575	100.0	492	100.0

In all, 46 Quaternary pollen taxa were identified in the re-examined samples. These taxa, together with representative examples and common names, are provided in Table 5. There are some discrepancies between this list and that previously reported. Some of these were rare taxa which simply were not encountered in this re-examination. Others, such as _Juglans_ and _Ostrya_-_Carpinus_ types, were found to be possibly pre-Quaternary taxa and so were not included. Nor could the identification of _Larix_ be confirmed. The pollen of _Larix_ is nondescript sphere. Only macrofossil evidence would be definitive proof of _Larix_'s presence. _Populus_, only identified to species in last year's report has been divided into two taxa _P_. cf. _tremuloides_ and _P_. cf. _balsamifera_. All of the Quaternary pollen and spore taxa identified are present today in the boreal forests and plains of Canada. Relative frequencies (percentages) of identified Quaternary pollen taxa is given in Table 6 for each of the spruce zone samples.

Table 5

A list of the Quaternary pollen taxa identified, and some representative species included within each pollen taxa.

AP Taxa	Representative Sp.	Common Name
Abies	*A. balsamea*	balsam fir
Picea	*P. glauca*	white spruce
Pinus	*P flexilis*	limber pine
	P. banksiana	jack pine
Juniperus	*J. communis*	common juniper
Quercus	*Q. macrocarpa*	bur oak
Betula	*B. papyrifera*	white birch
Alnus	*A. rugosa*	alder
Shepherdia	*S. argentea*	buffaloberry
Salix	*S. interior*	sandbar willow
Corylus	*C. cornuta*	beaked hazelnut
Populus cf. *balsamifera*		balsam poplar
Populus cf. *tremuloides*		quaking aspen
Acer negundo		boxelder
Cornus cf. *canadensis*		bunchberry
Carya	*C. ovata*	shagbark hickory

NAP Taxa		
Artemisia	*A. tridentata*	big sagebrush
Ambrosia	*A. trifida*	giant ragweed
Iva type	*I. axillaris*	povertyweed
	Xanthium strumarium	cocklebur
Eupatorium type	*E. altissimum*	joe-pye-weed
Tubliflora type	*Carduus nutans*	musk thistle
Bidens type	*B. cernua*	beggar-ticks
Helianthus type	*H. annuus*	common sunflower
Agoseris type	*A. glauca*	false dandelion
Cheno-Am	*Chenopodium desiccutum*	goosefoot
	Amaranthus retroflexus	pigweed
Poaceae (Grass Family)		
	Panicum virgatum	switchgrass
	Bouteloua gracilis	blue grama
	Buchloe dactyloides	buffalo grass
Cyperaceae (Sedge Family)		
	Carex brevior	fescue sedge
	Eleocharis acicularis	spike sedge
Onagraceae (Evening Primrose Family)		
	Oenothera biennis	evening primrose
Rosaceae (Rose Family)		
	Rosa blanda	wild rose
	Geum canadense	white avens
Polygonum	*P. arenastrum*	knotweed
Saxifraga	*S. cernua*	saxifrage
Apiaceae (Hemlock Family)		
	Cicuta maculata	water hemlock
	Osmorhiza longistylis	aniseroot

Table 5 - Identified Quaternary pollen taxa: (continued)

NAP Taxa

Solanaceae (Nightshade Family)		
	Physalis hederifolia	ground cherry
	Solanum Interius	nightshade
Lycopus-Mentha	L. americanus	bugleweed
	M. arvensis	mint
Stachys type	S. palustris	hedge-nettle
Utrica type	Pilea fontana	clearweed
Euphorbiacease (Spruce Family)		
	Euphorbia serpens	spurge
Typha type	T. angustifolia	cattail
Sagittaria	S. Iatifolia	arrowhead
Ranunculus type	R. cardiophyllus	buttercup
Lycoodium	L. obscurum	clubmoss
Cystopteris	C. bulbifera	bladder fern
Pteridium type	P. pubescens	bracken fern

Table 6

Relative frequencies (percentages) of pollen taxa from spruce lens samples, North Cove. Pollen percentages for each sample may not sum to 100 percent due to rounding error. Percentages based on total identified Quaternary pollen and spores.

	Sample		
AP Taxa	1	2	3
Abies	0.0	0.4	0.0
Picea	43.2	30.9	29.9
Pinus	6.8	3.7	2.4
Juniperus	2.4	2.7	17.2
Quercus	2.1	1.6	2.4
Betula	2.0	1.6	0.9
Alnus	1.4	1.0	0.0
Shepherdia	0.0	1.2	0.2
Salix	1.7	0.6	0.7
Corylus	0.3	0.8	0.5
Populus balsamifera	1.0	0.8	1.6
Populus tremuloides	2.4	2.9	2.6
Acer negundo	1.0	0.2	0.5
Cornus cf. canadensis	0.0	0.0	0.2
Carya	0.3	0.0	0.2

Table 6 - Continued

NAP Taxa	Sample 1	Sample 2	Sample 3
Artemisia	2.4	3.3	3.1
Ambrosia	2.1	2.7	2.1
Iva type	0.3	0.8	0.7
Eupatorium type	1.7	0.2	0.5
Tubliflora type	0.3	0.2	0.5
Bidens type	0.7	0.4	0.2
Helianthus type	0.3	0.0	0.0
Agoseris type	0.0	1.0	0.9
Cheno-Am	5.5	1.4	1.4
Poaceae	7.2	9.7	8.9
Cyperaceae	5.5	11.9	9.4
Onagraceae	0.3	0.2	0.0
Rosaceae	0.3	1.4	0.2
Polygonum	0.7	0.4	0.0
Saxifraga	0.0	0.0	0.2
Apiaceae	1.7	0.0	0.7
Solanaceae	1.7	0.4	0.2
Lycopus-*Mentha* type	0.0	0.2	0.2
Stachys type	3.4	1.4	0.2
Utrica type	1.4	0.2	0.9
Euphorbiaceae	0.3	0.2	0.5
Typha type	0.7	3.3	2.8
Sagittaria	0.0	0.0	0.2
Ranunculus type	0.7	0.0	0.9
Lycopodium	0.7	0.2	0.5
Cystopteris	1.4	11.3	5.1

The three spruce-zone samples give a consistent signal of the late-Wisconsinan vegetation. Typically about 60 percent of the primary pollen sum (AP + NAP) is arboreal. The most important of these arboreal pollen (AP) taxa is *Picea*, comprising about 35 percent of the primary pollen sum. The most common other arboreal taxa include *Pinus*, *Juniperus*, *Populus*, and *Quercus*. The presence of *Pinus* in the relative frequencies occurring here (averaging 4 percent) is not significant. This amount of pine pollen is probably due to long-distance transport but may also represent a few trees growing locally. The occurrence of *Juniperus* pollen, especially in the high (ca. 17%) frequencies found in Sample 3, indicates that one or more of the shrubby junipers commonly associated with spruce forest were present at North Cove. *Populus* pollen is notoriously under-represented in pollen records. The consistent presence of two taxa of *Populus* pollen, even in low percentages indicates that aspen or other *Populus*, and the balsam poplar, were important trees in the North Cove late-Pleistocene vegetation. Also present but not regionally dominant were a variety of other deciduous arboreal taxa. The most common of these probably was *Quercus*. The diversity of other deciduous pollen taxa listed on Table 6 together sum to a significant portion of the pollen record. This occurance probably represent local presence of these taxa rather than long distance pollen transportation.

It is always difficult to judge what portion of a non-arboreal pollen (NAP) is strictly local and site specific, and how much is regional. Most of the North Cove spruce-zone NAP could be the result of marshes surrounding the springs; however, based on recent findings in eastern Kansas (Fredlund and Jaumann, 1987), it is believed that the dominant regional vegetation may have been open aspen parklands or grovelands. Spruce was probably far more common in mesic and fire-protected localities such as North Cove. The consistent presence of *Populus* and the relatively high overall percentage of NAP, especially *Artemisia*, *Ambrosia*, Poaceae and Cyperaceae, in the North Cove spring deposits are consistent with this regional hypothesis.

Macrofossil Analysis

The most common identifiable macrofossils are from *Picea* (Table 7). Spruce needles and the pegs which attach the needles to the twigs occur by the thousands in both samples. There are a few needles which appear not to be from spruce. These short needle fragments are probably *Juniperus*. However, no *Juniperus* seeds have been found so far.

Table 7

Tentative botanical macrofossil identification from the North Cove, "spruce zone". Sample numbers correspond with those for the pollen analysis. Portion of the plant identified is listed in body of the table.

Taxa	Sample 1	Sample 2
Picea	Wood, Twigs, Needles	Wood, Twigs, Needles
Juniperus(?)	Needles	
Populus	Seeds	Seeds
Rosaceae	Seeds	Seeds
Asteraceae	Seeds	Seeds
Poaceae	Seeds	Seeds
Lamiaceae	Seeds	Seeds
Cyperaceae	Seeds	Seeds
Brassicaceae(?)	Seeds	
Polygonum(?)	Seeds	

Other taxa, represented by seeds are not yet firmly identified (Table 7). Several hundred seeds representing about 12 taxa have been isolated so far. Many of these seeds have been identified to family but should eventually be identifiable to genera or species. It is also important to note that many of the seed taxa identified include potentially important resources available to early man at North Cove.

Conclusions

Fossil-bearing spring deposits at the North Cove Site contain abundant pollen and botanical macrofossils from the open, mixed spruce-deciduous parkland of the late Wisconsinan. Included in this Republican river valley vegetation were white spruce, juniper, aspen, poplar, boxelder, oak, alder, hazel, willow, birch, and soapberry. The regional vegetation of the uplands away from the river valley is uncertain. Recently-discovered evidence in eastern Kansas (Fredlund and Jaumann, 1987), suggests a more open, less diverse vegetation such as aspen parkland or groveland in the uplands. The occurrence of aspen and relatively high frequencies of non-arboreal pollen from North Cove is consistent with this interpretation.

CHAPTER 5

PALEONTOLOGY AND PALEOECOLOGY OF THE 1987 EXCAVATION OF THE NORTH COVE SITE, 25HN164

J. D. STEWART

Introduction

This chapter reports the paleontological findings of the 1987 excavation at the North Cove site, 25HN164, Harlan County Lake, Nebraska. The objective of this investigation was to test the conclusions drawn from the 1985 excavation of this site through an expanded exploratory excavation. Conclusions regarding the 1985 excavation (Stewart, 1987c) were that a human modified artifact was recovered in the context of extensive Late Wisconsinan pleniglacial biota, specifically of the Woodfordian substage of the Wisconsinan glaciation. Radiocarbon dates from the Woodfordian horizon ranged from 14,700±100 to 12,965±135 yr. B.P. The environmental interpretation of the associated biota was that the paleovalley of the Republican River or a tributary at that time supported extensive stands of white spruce (*Picea glauca*) with many clearings that could contain organisms typical of northern grasslands. Younger deposits at this site produced a somewhat different biota and were judged to be of Two-Creekan age. Nearly all of the large *Bison* bones were found in the Two-Creekan horizons.

The present report focuses on those fossils from the 1987 excavation units which produced the lithic artifacts. While these constitute only a portion of the total paleontologic collection, the analysis of these fossils have added greatly to a reconstruction of the paleoecology of the North Cove site. In addition, few of the scientific names of organisms in this report are updated from the usage of Stewart (1987c). These include *Columella columella* (= *Columella alticola*) and *Cochlicopa lubrica* (= *Cionella lubrica*).

Stratigraphy

Prior to removal of the sediments above the datum of test units A, B, D, and I (approximately 6 m below the top of the cliff, see Fig. 5, Ch. 2), matrix samples were collected from 20 cm above datum (JDS-87-32) and 30 cm below the datum (JDS-87-31). The latter sample was nearly devoid of fossils, but the upper produced teeth of the prairie vole (*Pitymys ochrogaster*) and meadow vole (*Microtus pennsylvanicus*). Following removal of the upper sediments and the formation of platform 2, four 1-meter-square test units were excavated to the depth of sterile sand.

No artifacts were encountered in the upper 120 cm below unit datum test units. Nonetheless, it is instructive to look at the biostratigraphic sequence in the first 50 cm. As mentioned above, the 20 cm above unit datum produced teeth of the prairie vole and the meadow vole. Except for one specimen found in 1985, this is the only record of *Pitymys* so far recovered from the site. The prairie vole (*Pitymys ochrogaster*) is the only common vole living in the area of that site today. The first 10 cm of the excavation produced an oviparous snake (the hognose snake, *Heterodon* sp.), spruce grouse (*Dendragapus canadensis*), a vole of the genus *Microtus*, and two snails, *Vallonia gracilicosta* and *Vertigo gouldi*. The second 10 cm interval produced spruce (*Picea* sp.) charcoal and the first snail of the genus *Discus*. In the third 10 cm interval, the first burnt bone and the first specimens of the snails *Discus cronkhitei* and *Vertigo modesta* were encountered. The first examples of the yellow-cheeked vole (*Microtus xanthognathus*) and the snails *Discus shimeki* and *Pupilla muscorum* came from the fourth 10 cm interval. The first specimens of the snowshoe hare (*Lepus americanus*), the heather vole (*Phenacomys intermedius*), the least chipmunk (*Tamias minimus*), and Arctic shrew (*Sorex arcticus*) were recovered from the fifth 10 cm interval. These and other taxa from the first 50 cm are summarized in Table 8. Except for the prairie vole and the snake, none of the above organisms live in Harlan County, Nebraska, today; instead they can be found various distances to the north or at high elevations in the Rocky Mountains.

Table 9 lists the organisms associated with artifact 1 (Unit D 120-130 cm below datum). Nearly all of these taxa are consistent with a spruce parkland with an associated stream, and nearly all were reported from the 1985 excavation at the site. The snail, *Gastrocopta* cf. *falcis*, was not reported in the 1985 excavation. It is not known to be alive today anywhere.

Unit D produced artifact 2 at 130-140 cm below datum. The associated fauna is listed in Table 10. This list is not as extensive as in the previous unit, but those taxa known thus far except for the heather vole (*Phenacomys*) are all included among those from the 120-130 cm level of Unit D.

Artifact 3 came from the sandy facies of the 120-130 cm level of Unit B. The associated biota is listed in Table 11. The clay facies from that unit (Unit B 120-130B) produced an essentially identical list of organisms as can be seen in Table 12. With the exception of the fish genus *Hiodon* (mooneye and goldeye), *Cynomys* (prairie dog), and the angiosperm charcoal, all these taxa were recorded in Woodfordian horizons in the 1985 excavation. Specimens from another horizon (Unit B, 130-140 cm below unit datum) demonstrate that the *Hiodon* species is *Hiodon alosoides* (goldeye). The *Cynomys* teeth from Unit B, 120-130B are not

TABLE 8
Identified Taxa from upper 50 cm of deposits below platform 2, North Cove Site.

JDS-87-32

Pitymys ochrogaster (prairie vole)
Microtus pennsylvanicus (meadow vole)

UNIT A
0-10 cm

Heterodon sp. (hognose snake)
Dendragapus canadensis (spruce grouse)
Thomomys sp. (gopher)
Microtus pennsylvanicus or *montanus* (vole)

10-20 cm

Picea charcoal (spruce)
M. pennsylvanicus or *montanus* (vole)
Thomomys
Vallonia sp. (snail)
Helicodiscus p. (snail)

20-30 cm

Vallonia gracilicosta (snail)
Gastrocopta armifera (snail)
Vertigo gouldi (snail)
succineid
Discus cronkhitei (snail)
Vertigo modesta (snail)
Zonitoides arboreus (snail)
burned bone

30-40 cm

soricid
Vallonia gracilicosta (snail)
Gastrocopta armifera (snail)
Vertigo gouldi (snail)
Vertigo modesta (snail)
Pupilla muscorum (snail)
Discus cronkhitei (snail)
Discus shimeki (snail)
Hawaiia minuscula (snail)
Zonitoides arboreus (snail)

TABLE 8 continued

40-50 cm

Microtus _pennsylvanicus_ or _montanus_ (vole)
Lepus cf. _americanus_ (snowshoe hare)

calcined bone

UNIT B
10-20 cm

Vallonia _gracilicosta_ (snail)
Gastrocopta _armifera_ (snail)
Discus sp. (snail)

20-30 cm

coniferous charcoal

40-50 cm

Picea charcoal (spruce)
Microtus _xanthognathus_ (yellow-cheeked vole)

UNIT I
0-30 cm

Thomomys sp. (gopher)
_V._ _gracilicosta_ (snail)
Vertigo _gouldi_ (snail)

30-40 cm

Microtus cf. _xanthognathus_ (yellow-cheeked vole)
Microtus _pennsylvanicus_ or _montanus_ (vole)
Vallonia _gracilicosta_ (snail)
Vertigo cf. _gouldi_ (snail)

40-50 cm

Phenacomys _intermedius_ (heather vole)
cf. _Tamias_ _minimus_ (least chipmunk)
sorex _arcticus_ (Arctic shrew)

TABLE 9

Identified Taxa from Unit D, 120-130 cm below unit datum, North Cove Site

taxon	MNI*	Percentage
MOLLUSCS		
Pisidium sp. 12/2 =	6	
Carychium exiguum	2	0.18
Cochlicopa lubrica	2	0.18
Vallonia gracilicosta	474	41.91
Pupilla blandi	28	2.47
Pupilla muscorum	40	3.54
Pupoides albilabris	1	0.09
Gastrocopta armifera	87	7.69
Gastrocopta tappaniana	2	0.18
Gastrocopta cf. falcis	1	0.09
Vertigo ovata	1	0.09
Vertigo gouldi	33	2.92
Vertigo modesta	63	5.57
succineids	230	20.33
Discus cronkhitei	53	4.69
Discus shimeki	15	1.33
Helicodiscus parallelus	6	0.53
Punctum minutissimum	15	1.33
Deroceras laeve	48	4.23
Nesovitrea electrina	3	0.27
Hawaiia minuscula	12	1.06
Zonitoides arboreus	14	1.23
Euconulus fulvus	1	0.09
total:	1131	100.00
OSTRACODES	1	
FISH		
cyprinid (minnow)		2
Stizostedion sp. (walleye or sauger)	1	
AMPHIBIANS		
Rana sp. (frog)	4	
Ambystoma tigrinum (tiger salamander)	1	
REPTILES		
colubrid (snake)	2	
BIRDS		
charadriiform (shore bird)	1	

TABLE 9 continued

taxon	MNI	Percentage
MAMMALS		
Sorex cinereus (masked shrew)	1	.03
Lepus americanus (snowshoe hare)	1	.03
Thomomys talpoides (northern pocket gopher)	1	.03
Spermophilus tridecemlineatus (Thirteen lined ground squirrel)	1	.03
Spermophilus kimballensis (Kimball ground squirrel)	5	.18
cf. *Cynomys* sp. (prairie dog)	1	.03
Microtus xanthognathus (yellow-cheeked vole)	1	.03
Microtus pennsylvanicus (meadow vole)	7	.24
Microtus montanus (montane vole)	2	.08
Microtus sp. (vole)	3	.10
Synaptomys borealis (northern bog lemming)	1	.03
Clethrionomys gapperi (Gapper's red backed vole)	4	.13
Peromyscus sp. (deer or white footed mouse)	1	.03
Zapus princeps (western jumping mouse)	1	.03
total:	30	100.00

*Minimum number of individuals

TABLE 10

Identified Taxa from Unit D, 130-140 cm below unit datum, North Cove Site

	MNI	Percentage
MOLLUSCS		
Vallonia gracilicosta	19	26.38
Pupilla sp.	1	1.39
Gastrocopta armifera	5	6.94
succineids	21	29.17
Discus shimeki	2	2.78
Zonitoides arboreus	1	1.39
Discus cronkhitei	21	29.17
Deroceras laeve	2	2.78
total:	72	100.00
OSTRACODES 3/2	2	
AMPHIBIANS		
Rana sp.	1	
MAMMALS		
Microtus sp.	2	28.58
Thomomys talpoides	1	14.28
Microtus pennsylvanicus	1	14.28
Clethrionomys gapperi	2	28.58
Phenacomys intermedius (heather vole)	1	14.28
total	7	100.00

TABLE 11

Identified Taxa from Unit B, 120-130A cm below unit datum, North Cove Site

taxon	MNI	percentage
MOLLUSCS		
Fossaria dalli	1	.03
Columella columella	1	.03
Carychium exiguum	116	3.79
Cochlicopa lubrica	8	.26
Vallonia gracilicosta	1496	48.99
Pupilla blandi	18	.59
Pupilla muscorum	16	.52
Gastrocopta armifera	227	7.44
Gastrocopta cf. *falcis*	143	4.69
Gastrocopta tappaniana	40	1.30
Vertigo ovata	14	.45
Vertigo gouldi	218	7.14
Vertigo modesta	200	6.56
succineids	154	5.04
Discus cronkhitei	125	4.09
Discus shimeki	39	1.29
Punctum minutissimum	46	1.50
Nesovitrea electrina	28	.92
Hawaiia minuscula	63	2.06
Zonitoides arboreus	83	2.72
Euconulus fulvus	18	.59
total	3054	100.00
OSTRACODES 5/2	3	
FISH		
Hiodon sp.(mooneye or goldeye)	1	
AMPHIBIANS		
Rana sp.	27	
Bufo hemiophrys (Wyoming toad)	1	
BIRDS		
phasianid (grouse)	1	
indet.	1	
shell fragments	10	

TABLE 11 Continued

taxon	MNI	percentage
MAMMALS		
Sorex cinereus	1	2.86
Lepus americanus	1	2.86
Thomomys talpoides	3	8.57
Spermophilus tridecemlineatus	1	2.86
Spermophilus kimballensis	1	2.86
Phenacomys intermedius	2	5.70
Clethrionomys gapperi	5	14.28
Microtus xanthognathus	1	2.86
Microtus montanus	1	2.86
Microtus pennsylvanicus	10	28.57
Microtus sp.	6	17.14
Synaptomys borealis	1	2.86
Zapus princeps	1	2.86
cf. *Bison* sp.	1	2.86
total:	35	100.00

TABLE 12

Identified Taxa from Unit B, 120-130 B cm below unit datum
North Cove Site

taxon	MNI	percentage
MOLLUSCS		
Carychium exiguum	18	3.94
Cochlicopa lubrica	2	0.44
Vallonia gracilicosta	206	45.18
Pupilla blandi	7	1.54
Pupilla muscorum	1	0.22
Gastrocopta armifera	46	10.09
Gastrocopta cf.falcis	12	2.63
Gastrocopta Tappaniana	1	0.22
Vertigo ovata	2	0.44
Vertigo modesta	27	5.91
Vertigo gouldi	53	11.62
succineids	11	2.41
Discus cronkhitei	23	5.04
Discus shimeki	4	0.88
Punctum minutissimum	16	3.50
Nesovitrea electrina	6	1.32
Hawaiia minuscula	9	1.98
Zonitoides arboreus	9	1.98
Euconulus fulvus	3	0.66
total:	456	100.00
FISH		
cyprinid	1	
Stizostedion sp.	1	
AMPHIBIANS		
Rana sp.	12	
Bufo hemiophrys	1	
Ambystoma tigrinum	1	
REPTILES		
natricine colubrid	1	
BIRDS		
passeriform (song bird)	1	
charadriiform	1	
galliform	1	

TABLE 12 Continued

taxon	MNI	percentage
MAMMALS		
Sorex cinereus	2	14.30
Sorex cf. *arcticus*	1	7.14
Thomomys talpoides	1	7.14
cf. *Tamias minimum* (least chipmunk)	1	7.14
Spermophilus tridecemlineatus	1	7.14
Cynomys sp.	1	7.14
Clethrionomys gapperi	1	7.14
Microtus xanthognathus	1	7.14
Microtus pennsylvanicus	1	7.14
Microtus sp.	2	14.30
Ondatra zibethicus (muskrat)	1	7.14
cf. *Bison* sp.	1	7.14
total:	14	100.00

sufficient to identify to the level of subgenus, but teeth from Unit B, 130-140A are like those of the extant members of the subgenus Leucocrossuromys, none of which can be found in Nebraska today.

Artifact 4 was collected from the 160-170 cm level of Unit B. Table 13 lists the associated biota. Again, the list is essentially identical to those associated with the other artifacts. All are consistent with a Woodfordian spruce parkland.

Samples collected along the extent of the clays and spring pipes confirmed the finding of the 1985 excavation that the biota in the southern part of these facies differs from that of the northern part. Those facies of this type penetrated by Units A, B, D, and I lie at the southern end and produce faunas with very few Pisidium (pea clams). Likewise, they produce no Gyraulus or Gastrocopta contracta. Vallonia gracilicosta constitutes 25-80% of the snail fauna. The total percentage of aquatic snails is less than 1% of the snail fauna. Discus shimeki is moderately abundant. This fauna has a typically Woodfordian appearance.

In the northern part, Pisidium is common and is the most common mollusc in many samples. Gyraulus and Gastrocopta contracta are not uncommon. Vallonia is less than 8% of the snail fauna. The total percentage of aquatic snails is over 10% of the snail fauna. Discus shimeki is rare or absent. Strobilops makes its only known appearance at the site in the northern part of these facies. When combined with the vertebrates (Stewart, 1987c), these data convey the impression of a somewhat warmer climate with more deciduous trees.

Discussion

The only horizons that produced any cultural remains were of Woodfordian age. Organisms that might be of cultural significance to humans and which came from the units that produced the artifacts include the goldeye, the sauger, the birds, the snowshoe hare, muskrat, and bison. In Unit B 120-130A and Unit B 120-130B, small fragments of the skull of a large ungulate, presumably a bison, show evidence of having been burnt. Such burned fragments also were found in levels 110-120A, 130-140A, 130-140B, and 140-150B of Unit B. Some sides of these fragments are black, and other surfaces are entirely white, indicating exposure to extreme heat. It seems unlikely that natural processes would first fragment these bones and then subject them to sufficient heat to turn them white. If the fragmentation and burning of the Bison bone fragments were the result of natural processes, one might expect the more delicate bones of birds and small mammals from the same deposits to be more extensively fragmented than they are. One might also expect many of the

TABLE 13

Identified Taxa from Unit B, 160-170 cm below unit datum
North Cove Site

taxon	MNI	percentage
Picea charcoal		
MOLLUSCS		
Carychium exiguum	8	0.64
Cochlicopa lubrica	1	0.08
Vallonia gracilicosta	556	44.62
Pupilla blandi	49	3.93
Pupilla muscorum	60	4.82
Gastrocopta armifera	67	5.38
Vertigo gouldi	103	8.27
Vertigo modesta	77	6.18
Columella columella	1	0.08
succineids	86	6.90
Discus cronkhitei	108	8.67
Discus shimeki	41	3.29
Helicodiscus parallelus	6	0.48
Punctum minutissimum	18	1.44
Deroceras laeve	1	0.08
Nesovitrea electrina	10	0.80
Hawaiia minuscula	10	0.80
Zonitoides arboreus	25	2.01
Euconulus fulvus	19	1.52
total:	1246	99.99
OSTRACODES 44/2	22	
AMPHIBIANS		
Rana sp.	1	
BIRDS		
charadriiform; cf. scolopacid	1	
MAMMALS		
Sorex cf. arcticus	1	
Lupus americanus	1	
Microtus xanthognathus	1	

small bones to be at least as extensively burned as the *Bison* bones, but this is not the case. A very few of the small bones are darkly colored, but this may be the result of permineralization. None show the starkly white condition of many of the *Bison* fragments.

The excavation units that produced the artifacts are all overlain by a layer of silt which underlies a paleosol dated at about 11,500-10,200 yr. B.P. (Johnson, this volume). There is no evidence of animal burrowing having penetrated the paleosol; it maintains its integrity throughout its exposed extent. Most of the bison elements are from the silt. Those from this silt stratum yielded dates of 11,020±635 (UGa-5475) and 11,363±865 B.P. (UGa-5480). Laminated organic-rich sediments at the base of the silt have been dated at 12,620 ± 160 B.P. (Tx-6610). The paleosol and laminated sediment dates could be interpreted as indicating that the bone dates are a bit too young, as is frequently the case with radiocarbon dates on bones. Spring activity from below has penetrated the organic-rich sediments in places (Johnson, this volume). This phenomenon was only in the northern part of the cut bank, i.e. a zone of renewed spring activity. Spruce wood samples from clays adjacent to some of the spring pipes at the southern end of the spring deposits produced dates ranging from 12,650 ± 250 (Beta-18,188) to 14,700 ± B.P. (Beta-12,286). Within this part of the exposure; the spring pipes do not approach the organic-rich laminations. If the spring activity in Units B and D disturbed the stratigraphic position of the artifacts, it could not have significantly altered their stratigraphic context. The spring pipes do not extend into post-Woodfordian sediments. As Logan has demonstrated (chapter 6, this volume), the artifacts may have been secondarily derived from a primary source up slope on the paleotopography (to the west). It is concluded that all paleontologic and stratigraphic evidence indicates that these artifacts are of Woodfordian age.

Additional Findings

The site is incurring rapid destruction. Our measurements indicate that at the beginning of the 1987 excavation, the cliff face had been set back approximately 1 meter from where it was at the end of the 1985 excavation. Had we not investigated the site prior to 1987, we would know very little of the plant macrofossil record at this site. The clay unit that produced the wealth of plant macrofossils was largely depleted by 1987. The few sizeable pieces of wood that had been present in the sediments excavated in 1987 were apparently oxidized. Only elongate voids were left. This interpretation of the voids was verified by filling some with plaster of paris. The resulting casts were clearly of sticks up to 33 cm in diameter.

As stated in Stewart 1987c, Strobilops labyrinthica occurs at North Cove only in the anomalous deposits north of profile 2. Therefore, the inclusion of that taxon in the lists of taxa from that site published by Wells and Stewart (1987a, b) is misleading in that it implies that Strobilops was a Woodfordian inhabitant of the site. The Strobilops record there probably dates from a later time.

As stated above, the snail Gastrocopta cf. falcis has not been reported from Late Pleistocene sediments. Several molluscs first described from Late Pleistocene fossils were later found to be living in parts of North America. This snail may eventually prove to be one of those. It has never before been reported from Nebraska (Hubricht, 1985). However, that species may prove to be conspecific with Gastrocopta holzingeri (Stewart and Coney, in prep.). The latter species currently ranges into western Nebraska and was reported from a single specimen in the 1985 excavation (Stewart, 1987c).

After the report of the 1985 excavation (Adair and Brown, 1987) was completed, Dr. Richard M. Forester provided identification of a few ostracodes from the more recent spring deposits north of the 1987 excavations. He identified them as Potamocypris pallida and a new species of Candona. He also stated that P. pallida "is only known from springs, typically spring vents. Based on limited information it probably lives in the aquifer and is discharged at spring vents. It lives in Canada and the United States as well as northern Europe, is restricted to dilute water, which is typically between about 10 ppm and 300 ppm, and is generally restricted to cold water, which based on my own observations could mean less than 10 degrees C." (Forester, written comm., 1987). These findings agree with earlier findings (Stewart, 1987c) that part of the deposits represent a spring deposit. It is also consistent with predictions that the water temperature in which the unit was deposited was colder than might be expected in most water bodies there today, but that the environment was not as cool as waters associated with the excavated, Woodfordian-age spring. The climate seems to have ameliorated somewhat between accumulation of the pleniglacial Woodfordian spring sediments and those of the post-Woodfordian spring several meters to the north.

Stewart (1987c) reported a sucker (family Catostomidae) from the 1985 excavation. The available material did not permit identification of the species of sucker. The 1987 excavation produced a catostomid maxilla in Unit B 140-150A, and it definitely belongs to the white sucker, Catostomus commersoni. Another fish identified from the 1987 excavation is the goldeye (Hiodon alosoides). The goldeye is not known as a fossil in the Great Plains after 2 MYBP. Thus, this is the first Pleistocene record of that species in this area. The goldeye inhabits Nebraska today, but is not known from any historical records as high up the Republican River as Harlan County. This probably indicates greater stream flow during the Late Pleistocene. Today the goldeye ranges as far north as the Makenzie River below Great Slave Lake in the Northwest Territories (Lindsey and McPhail, 1986). Like the sauger (Stizostedion canadense), recovered in both the 1985 and 1987 excavations, the goldeye possesses a tapetum lucidum, a reflective structure in the eye. It is related to visually-mediated predation in murky waters. From this we may extrapolate that the waters of the Republican River or tributary were turbid or murky.

Again, as in the 1985 excavation, no ictalurids (catfishes and flathead) were detected in the sediments thus far analyzed from the 1987 excavation, even though they are among the most easily preserved and detected remains of North American fresh water fishes. The apparent absence of ictalurids from Woodfordian sediment in northern Kansas and southern Nebraska accords with findings of Guilday et. al. (1978) and Dickinson (1982) in Tennessee, although both detected rare madtoms in Pleistocene horizons. Voorhies and Pierce (1989) similarly found esocids, percids, catostomids, salmonids and cyprinids in a periglacial Blancan deposit in Nebraska, but ictalurids were absent.

The most common bird identified in the 1987 collection is the spruce grouse (Dendragapus canadensis). Guilday et. al. (1977) stated that bones of the spruce grouse and the ruffed grouse (Bonasa umbellus) are difficult to differentiate. However, they concluded that the tarsometatarsi of spruce grouse are shorter and narrower than those of ruffed grouse. A tarsometatarsus from the 140 to 150 cm interval of Unit A conforms to this description. Guilday et. al. (1977) also noted that the pneumatic foramen in the spruce grouse humerus is proportionately larger and more rounded than in the ruffed grouse. No spruce grouse was reported from the 1985 excavation. However, KUVP 70358, collected in 1985 from the Woodfordian spring deposits (Unit K, "south spring": Stewart 1987c) agrees with this description. Stewart (1987c: 326) identified this specimen only as a small tetraonine. The distal end of a humerus collected from the first 10 cm below the datum of Unit A also appears more similar to the spruce grouse than the ruffed grouse in that its tubercle forming the attachment for the pronator brevis muscle is directed toward the palmar plane rather than somewhat toward the inner side. The spruce grouse is an inhabitant of swamps and spruce woodland. It does not live today in Nebraska, but ranges from Alaska, British Columbia, Washington, Idaho, and

Montana to the lower Hudson's Bay, the Great Lakes, to eastern Canada. It has been reported along with the ruffed grouse (Bonasa umbellus) from late Pleistocene cave sediments in Georgia (Wetmore, 1967) and Virginia (Guilday et al., 1977; Wetmore, 1962), but has not been noted heretofore in Pleistocene deposits in the Plains.

Another bird not noted from the 1985 excavation is the hudsonian godwit (Limosa haemastica). A proximal humerus of this bird was found in Unit A 130 to 140 cm below its datum. This bird is found beside pools and ponds and nests in the arctic tundra. Unlike the spruce grouse, this bird migrates over vast distances, wintering in South America, and is not such an accurate environmental indicator. This may represent the first fossil occurrence of this bird.

After the report on the 1985 excavation was prepared, Jeheskel Shoshani confirmed the identification of the mastodon vertebra found along the shore at the North Cove site as the third cervical vertebra of Mammut americanum (Shoshani, pers. comm., 1988). As noted by Johnson and Kost (1988), the western half of Kansas contains only 15% of the known records of mastodons in the state, and the predominance of mammoth in that area suggests a dominantly grassland environment. But the confirmed presence of mastodon in combination with spruce and boreal forest animals in a western Nebraska drainage having tributaries in western Kansas indicates that the western Central Plains were not without some woodland in the Late Pleistocene.

The long-tailed weasel (Mustela frenata) was also recovered from the 1987 excavation (Unit B 130-150), but not the 1985 excavation. It is perhaps the widest ranging of North American weasels, and tells us little about the paleoclimate.

Fossils from the spring deposits (Profile 2 of the 1985 excavation) indicated that the microfauna of the lower horizons was of Woodfordian age, and radiocarbon dates show that the Bison fossils from an overlying horizon were mostly of Two-Creekan age. Microfauna from that indicated it also might be of Two-Creekan age because of a somewhat milder climate than signaled by microfauna from units B through F of profile 2. However, the stratigraphic relationships of these deposits were unclear because unit J was several meters north of profile 2, and the intervening sediment contained many spring pipes. Microfaunal remains from 50 cm below datum to 20 cm above datum of the 1987 test pits show clear evidence of progressive climatic amelioration. Boreo-montane species seem to drop out in the following order: first, snowshoe hare, Arctic shrew, heather vole, and least chipmunk; second, yellow-cheeked vole, and the snails, Pupilla muscorum, and Discus shimeki; third Discus cronkhitei and Vertigo modesta;

fourth, northern pocket gopher, spruce grouse, and *Vertigo gouldi*; finally, the hognose snake and the prairie vole appear. At some subsequent point the meadow vole also disappeared, because it is no longer living in the area. A radiocarbon date of 11,020±635 B.P. from *Bison occidentalis* bones from overlying strata provides a minimum date for the disappearance of these species and the appearance of the hognose snake and the prairie vole. Other *Bison* remains from the same horizon (unit G of Stewart, 1987c and equivalent horizons) yielded a date of 11,365±865 B.P. As in the 1985 excavation, unit G and temporally equivalent horizons above the laminated organic layer, produced all the large bones of bison found during the 1987 excavation.

Conclusions

The North Cove site is of great archaeological and paleontological significance. The 1987 excavation confirms the findings that lithic artifacts occur in association with a biota from the Woodfordian substage of the Wisconsinan glaciation. Fragments of burned large ungulate bone, presumably from a bison, occur in conjunction with those artifacts.

Some of the species from this deposit were previously unknown as fossils; others have never before been found in Nebraska or the Great Plains; yet others have never been found in sediments of this age. Moreover, this is probably the only known site in the Great Plains which provides a continuous record of vertebrate fossils from Woodfordian through Two-Creekan times.

Chapter 6

Lithic Artifacts from the North Cove Site: The Pre-Clovis Problem in the Central Plains

Brad Logan

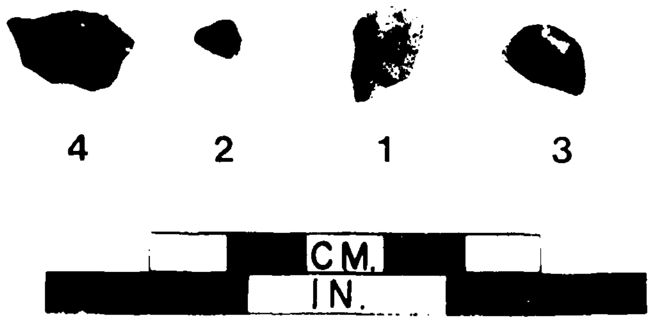
Introduction

In addition to the wealth of paleoenvironmental data obtained during the interdisciplinary investigation of the North Cove site, a small sample of lithic artifacts was recovered from the Late Pleistocene deposits. These artifacts, their stratigraphic provenience, attributes and bearing on the problem of a pre-Clovis occupation of the Central Plains, are discussed below.

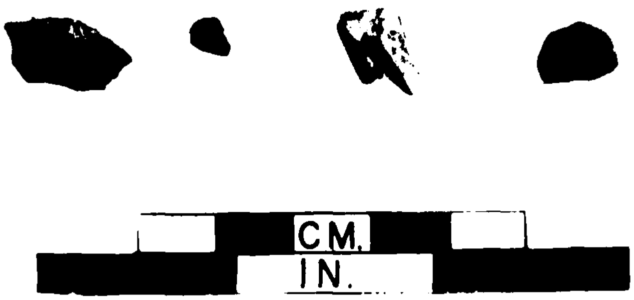
The Lithic Artifacts

The sample consists of four small flakes of chert, all found during the flotation process (Figures 31-32; Tables 14-15). Artifact 1 occurred in Test Unit D, 120-130 cm below its datum. It is a complete, non-cortical chip of Upper Republican Jasper. It measures 11.6 mm long (parallel to the axis of force), 11.3 mm wide, and 3.6 mm thick. Its distinctive attributes include a platform that is 2.8 mm wide and 8.0 mm long, a dual bulb of percussion and an eraillure scar. The dorsal face of the chip does not have any negative flake scars (the groove visible on this surface in Figure 32 is natural; Steve Holen, personal communication); both faces are patinated.

Artifact 2 was also recovered from Unit D but from the next lower level (130-140 cm below datum). It is a complete retouch, or resharpening, chip of Upper Republican jasper, 5.2 mm long, 6.4 mm wide, and 1.1 mm thick. Its distinctive attributes include a punch-type platform, bulb of force, and ventral hinge scar. The dorsal face bears one partial negative flake scar and both faces of the artifact are patinated. Artifact 3 occurred in Unit B, 120-130 cm below unit datum. It is a complete, non-cortical chip of Upper Republican jasper 9.7 mm long, 10.5 mm wide, and 1.8 mm thick. Its attributes include a punch-type platform, bulb of force, and distal hinge. Both faces of the artifact are patinated and a pale brown weathering rind occurs all along the perimeter of the flake.



A



B

Figure 31a. Ventral surface - view of flakes recovered from Horizon III at the North Cove site in 1987.

Figure 31b. Dorsal surface - view of above.

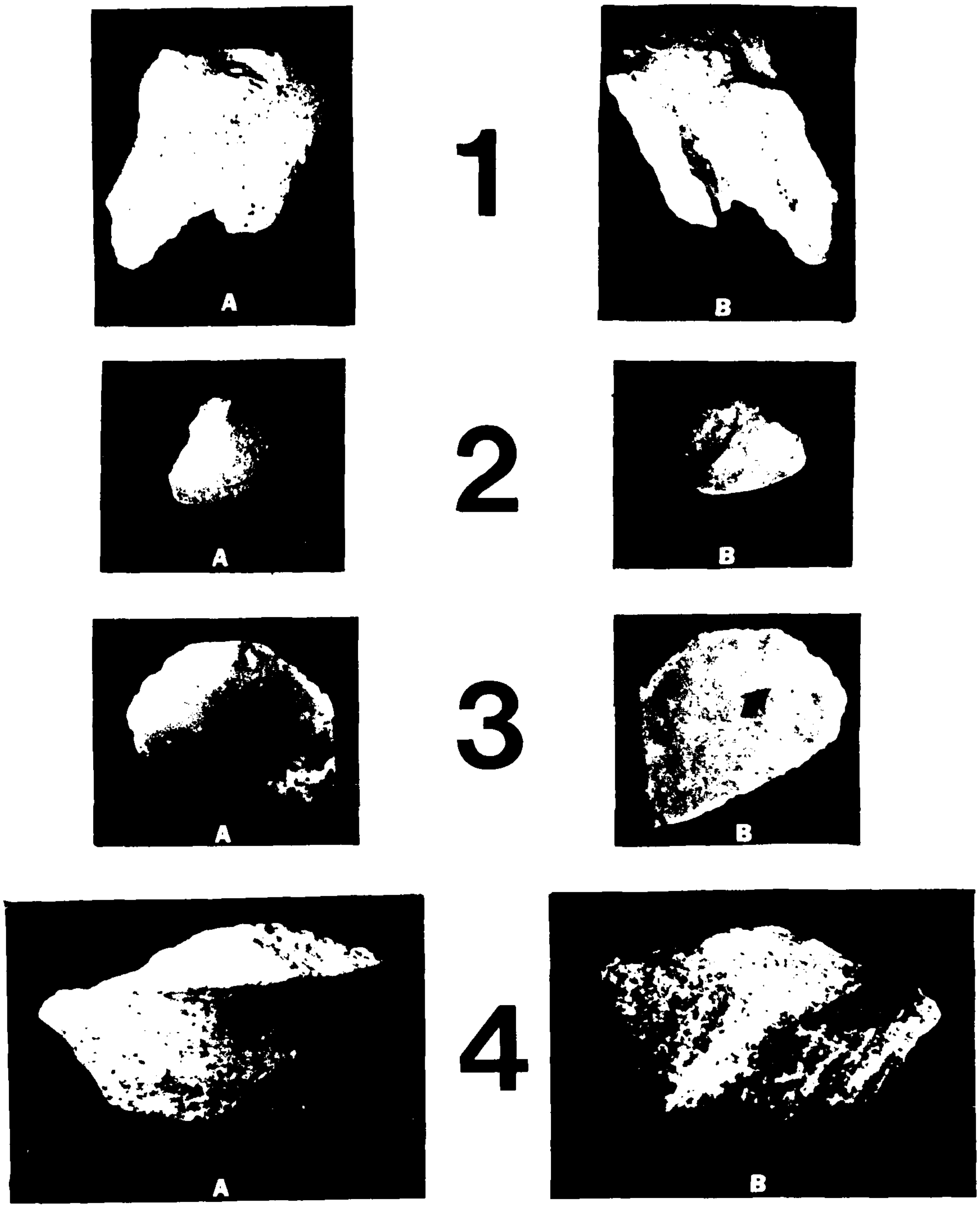


Figure 32. Artifacts 1-4 shown three times actual size.

Table 14

Metric Measurements (mm) of Artifacts from North Cove

Artifact No.	Length	Width	Thickness
1/complete	11.6	11.3	3.6
1/platform	2.8	8.0	
2/complete	5.2	6.4	1.1
3/complete	9.7	10.5	1.8
4/complete	9.7	17.1	5.4
4/platform	12.8	5.2	

Table 15

Nominal Attributes of Artifacts from North Cove

No.	Plat-form	Bulb of Force	Enrail-lure	Distal Hinge	Dorsal Flake Scars	Patina	Cortex
1	+	+	+	-	-	+	-
2	+	+	-	-	+	+	-
3	+	+	-	+	+	+	-
4	+	+	-	-	+	+	-

Artifact 4 was recovered from Unit B but, unlike the other flakes, its provenience was much lower in the Late Pleistocene horizon (160-170 cm below unit datum). It is a complete non-cortical chip of Upper Republican jasper 9.7 mm long, 17.1 mm wide, and 5.4 mm thick. Its attributes include a platform 5.2 mm wide, 12.8 mm long, and a bulb of percussion. The dorsal face bears two negative flake scars and both faces of the artifact are patinated.

None of the flakes has been retouched; neither do any display evidence of use-wear or platform preparation. The raw material type of the flakes was identified as Upper Republican jasper by Steve Holen (personal communication) based on criteria established by his research (Holen 1983) and that of Carlson and Peacock (1975). Sources of this material, also referred to as Niobrarite (Wright 1985), are common throughout the alluvial deposits in the Harlan County Lake Project Area. Holen also examined the flakes under low magnification and noted the presence of calcified sands on the surfaces of Artifacts 3 and 4. A small patch of this material is visible on the dorsal surface of Artifact 3 (Figure 32).

On the basis of his examination, Holen (personal communication) suggested the artifacts had been deposited in moving sand and experienced consequent surface abrasion. The surfaces of the artifacts then acquired deposits of calcified sand. Subsequently, the artifacts were redeposited to their site of recovery, during which transport the sand was removed from some of the flake surfaces and abraded, where it remains on Artifact 3. An alternative to this scenario offered by the author, however, eliminates the role of primary deposition in moving water. The nature of the spring deposits in which the artifacts were found provides all the forces necessary to explain the evidence of surface abrasion and calcified sands on the flakes. Within the excavated units, the gradient of the Late Pleistocene deposits is 30 cm per meter (see Figures 12-13 in Chapter 2). It is suggested that the archaeological (i.e., primary) deposition of the lithics occurred an indeterminable distance up (northwest) this paleo-slope and that subsequent slopewash transported them to their site of recovery. Once within Unit III, (see Johnson, this volume) however, the artifacts experienced abrasion by the medium and fine sands that had been piped upward into the silty clay matrix by spring action. These materials, as well as the carbonates above the coarser, cross-bedded basal sands, could also have been the source of the fine sands that became cemented to the artifact surfaces.

Unit III also included a lens of organic-rich clays with wood debris. Samples of this material collected in 1984 and 1985 were radiocarbon dated between 12,650 and 14,700 B.P. Additional samples of wood from this horizon were collected in 1987 from levels above and below those that yielded the artifacts. Radiocarbon dates from these samples bracket the age from 10,580 $\pm$ 2200 B.P. to 12,860 $\pm$ 1650 B.P. This horizon was also rich in remains of Wisconsinan microfauna, additional support of a Late Pleistocene age for the artifacts. As described above, the slope of the Late Pleistocene sediments suggests the original habitation site at which the lithics were first deposited was northwest of the cutbank and the excavations of 1985 and 1987. The small, comparable size and condition of the recovered artifacts suggests they have been transported by water from their original point of deposition. The artifacts, although contemporaneous with the associated biological remains in Unit III, are not in their primary context. It may be the case that the focal area of human occupation beyond the excavated area has been removed by erosion, with only the secondarily deposited sample remaining as evidence of activity in this area during pre-Clovis time. As detailed in chapter five, the associated faunal assemblage indicates the creators of this small lithic assemblage occupied a cool, boreal environment. Exactly how they adapted to this environment cannot be addressed with the data at hand. However minimal the data, their significance derives from their bearing on one of the most controversial problems in current archaeological research in the New World. A brief discussion of this problem is, therefore, warranted. In the next section, the pre-Clovis question is discussed with particular emphasis on other evidence from the Central Plains.

The Pre-Clovis Problem in the Central Plains

Establishing the antiquity of humans in the New World remains one of the most persistent problems in contemporary archaeology. Testimony to this is a recent series of articles which appeared from 1987-1988 under the title "The First Americans" in issues of the popular magazine Natural History. While aimed at the lay public, the articles were written by a variety of scholars who have addressed or are presently researching this problem. As the articles reveal, perspectives on the question of the date of the earliest human presence in the New World fall into at least two groups. Adherents to these perspectives all agree that humans had definitely appeared in the western hemisphere by 11,500 B.P. as evidenced by the Clovis culture, which occurred throughout North America from that time to above 11,000 years ago. However, one school of thought, represented by Paul S. Martin (1973, 1987; Mosimann and Martin 1975) and C. Vance Haynes (1968, 1980, 1988) remains skeptical about any evidence of an earlier occupation. It should be noted, however, that even Haynes (1969; 1970) has occasionally conceded the possibility of human occupation in North America early as 30,000 years ago. The other group consists of individuals convinced by radiocarbon dated cultural occupations at a number of sites, such as Meadowcroft Rockshelter in North America (Adovasio et al. 1978a, 1978b, 1980; Adovasio and Carlisle 1986) and Taima-Taima and Monte Verde in South America (Bryan 1987, Bryan et al. 1978; Dillehay 1986, 1987; Collins and Dillehay 1986), that human entry into the New World occurred prior to the appearance of the Clovis culture.

A third group may be composed of those who have yet to form a hard-and-fast opinion on the problem one way or the other. The author of this chapter is such an "open-minded" person (others may prefer to call such persons "fence-straddlers"). While the pre-Clovis problem has been reviewed in some recent works of broad geographical perspective (e.g., Bryan 1978, 1986; Ericson et al. 1982; Humphrey and Stanford 1979; Stanford 1982), the North Cove site and its bearing on that issue is best addressed from a more regional focus.

Prior to our excavations at North Cove, only a few sites in the Central Plains had yielded archaeological evidence reputed (and disputed) to be of pre-Clovis age. Three of these occur in the High Plains portion of this region and a fourth is located on its eastern margin. The following discussion of these sites begins with the latter.

The Shriver site (23DV12) is located in an upland setting on a remnant of the eroded Kansan-age till plain in Daviess County, Missouri. Its investigation in 1975 yielded evidence of a Woodland occupation and a Paleoindian fluted point assemblage. Stratified below the latter was an assemblage of chipped stone tools and debris suggested to have been produced "by a technique reminiscent of the Old World Levalloisoid technique" (Reagan et al. 1978:1272). Radiocarbon dating of the fluted point assemblage and the artifacts from the lower stratum was not possible. For absolute dating of these assemblages, thermoluminescence of heat treated chert artifacts from both was applied. When this technique was applied to the artifacts from the lower stratum, the resulting calculations were too varied to be considered accurate. However, artifacts from the lower portion of the stratum that yielded fluted points date to 12,855 ± 1500 B.C. On this basis, as well as the consistency of the date with relative dating of the site's geological stratigraphy, it was suggested that artifacts from the lower stratum were of pre-Clovis age. Recurrent occupation of the site throughout the prehistoric period was attributed to its location just 40 m from a spring on the apex of a spur overlooking the Grand River Valley (Reagan et al. 1978). Given the unreliability of the thermoluminescence technique, the date of the lower stratum from the Shriver site does not provide sufficient support for a pre-Clovis temporal placement (Stanford 1982:207).

The High Plains sites are Lamb Springs, Dutton and Selby, all located in northeastern Colorado and all investigated by Dennis J. Stanford (1979, 1982; Stanford et al. 1981a). The Dutton and Selby sites have comparable stratigraphy and faunal associations, although the former is located on a ponded stream channel and the latter occurs on a Pleistocene playa. Stanford (1982) summarizes the stratigraphic sequence for both, from the lowest level to the uppermost, as follows:

1) Peorian loess believed to have been deposited more than 17,000 yr B.P. that contains remains of camel, horse, and bison;

2) A series of lacustrine soils that developed between 12,000 and 17,000 yr B.P. that contain remains of mammoth, horse, bison, camel, sloth, peccary, and smaller mammals;

3) A gleysol radiocarbon dated to 11,710 ± 150 yr. B.P. that contains mammoth bones and, at the Dutton site only, Clovis age artifacts;

4) Sterile Holocene soils.

Stanford (1979) has suggested that some of the faunal remains from the lacustrine soils at both sites exhibit evidence of human modification. The cultural nature of these finds is still unclear. Stanford and others (1981b; cf. Stanford 1987) have conducted successful experiments with elephant bone-flaking in order to replicate flakes and tools comparable to those identified from Dutton and Selby. However, others have noted similar breakage patterns on bone from natural contexts (e.g., Myers et al. 1980; G. Haynes 1980, 1983). At the present time, the evidence of pre-Clovis activity at these sites remains equivocal.

Stanford and others (1981a) suggest the Lamb Spring site, located in the South Platte River basin in northeastern Colorado, also contained evidence of pre-Clovis activity. Excavations at the site in 1961 and 1962 by W. R. Wedel revealed a Cody bison kill stratified above Pleistocene faunal remains, including mammoth, bison, and camel, which dated to 13,140 ± 1,000 yr. B.P. (on bone collagen; Stanford et al. 1981a). No lithic artifacts were found at that level. Upon examination of the Pleistocene remains, breakage patterns comparable to those suggested to be of human manufacture from the Dutton and Selby sites were noted. This finding led to the reinvestigation of the Lamb Spring site in 1979 and 1980. As in the case of the North Cove site, the putative pre-Clovis finds recovered at Lamb Spring in 1961-1962 occurred within a silty clay stratum (albiet bluish green in color at Lamb Spring) that had been churned up by spring action and revealed a complex microstratigraphy. The later excavations were purposefully undertaken at an area more distant from the spring vent and less subject to aquaturbation. Material recovered at that time considered to be of cultural origin consisted of flaked mammoth bone, some fragments of which occurred in clusters within a bone bed of at least three mammoths, and a 33-pound boulder. The latter object occurred conspicuously out of its proper geomorphological context and bore traces of damage suggested to have been caused by its use as an anvil for flaking mammoth bone (Stanford et al. 1981a).

Of interest to our interpretation of the data from these four sites, as well as to those from the North Cove site, is Stanford and others' (1981a) evaluation of the Lamb Spring site in terms of four criteria they deem essential to validation of any pre-Clovis site. Their criteria (cf. Haynes 1969:714) include: 1) clearly defined stratigraphy, 2) reliable and consistent radiometric dates, 3) consonance of the data from various relevant interdisciplinary researches, and 4) unquestionable human artifacts in indisputable association. At the present time, all of the Central Plains sites of suggested pre-Clovis affiliation reviewed here do not adequately stand up to at least one or more of these criteria. All four sites have clearly defined stratigraphy. The Shriver site lacks radiometric dates, although the thermoluminescent dates correlate with the stratigraphic context of the putative pre-Clovis component and the recovered lithic assemblage is undoubtedly of human origin. The Selby and Dutton sites have consistent and reliable stratigraphic contexts and faunal remains consistent with a radiocarbon date on a Clovis-age stratum overlying putative modified bone artifacts. The Lamb Spring site is comparable in these regards except that the pre-Clovis stratum has been dated directly by radiocarbon assay of mammoth bone collagen. The weakest aspect of the High Plains sites is reliance on modified bones as the result of human manufacture. Given evidence from a number of recent studies demonstrating how such modifications can be the result of natural processes, critics of the pre-Clovis argument have reason to reject these sites as *bona fide* examples of human activity.

How do the North Cove site data appear in the light of the four criteria? The pre-Clovis deposits at North Cove (Unit III) consist of a series of silty clay horizons with intrusions of fine and medium sands. Their complex microstratigraphy is the result of vertical accretion of a spring depression. These deposits yielded a flaked piece of quartz during our investigations in 1985 (Adair and Brown 1987:287) and, during the fieldwork in 1987, at least four small chert flakes bearing attributes indicative of human manufacture. These artifacts are admittedly in a secondary depositional context. One could argue that aquaturbation so disrupted the deposits within the stratum that it is not possible to accept the flakes as being of pre-Clovis age. This overlooks the fact that all of the deposits of pre-Clovis agefrom which these finds were recovered underlies an organic rich stratum of clay which, while it is also the result of continued vertical accretion of the spring depression, is a distinctive stratum that effectively sealed the underlying deposits. Skeletal remains of *Bison occidentalis*, a grassland herbivore, found within this stratum have been radiocarbon dated from 11,020 to 11,365 yr. B.P. This "bison stratum" is of Clovis age, although no evidence of human activity has yet been found within it (e.g., the skeletal elements do not bear any trace of human modification). Whatever their original context, redeposition of the flakes within the underlying deposits had to have occurred prior to the deposition of the "bison stratum". Radiocarbon dates on spruce macrofossils from a clay lens within Unit III are consistently within the pre-Clovis range (see Table 1, Chapter 4). These dates are also compatible with the associated floral and faunal remains. On all accounts, the artifacts must be considered of undisputed pre-Clovis age.

I am not unaware of the fact that, under certain circumstances, chert and quartz can undergo spontaneous flaking or retouch. While conceding the possibility that the objects I describe as artifacts of human manufacture might have had a natural origin, I consider such an interpretation to be unsupportable at the present time. It must be recalled that our investigations consisted of relatively limited testing of the Late Pleistocene deposits. Recovery of a larger sample of such artifacts, or even more to be desired, the discovery of retouched flakes or formal chipped stone tools, would certainly strengthen our interpretation of their cultural origin. Haynes (1969:712-713) has noted how abundant chert "tools" at the Calico Hills site, near Yermo, California, suggested by its investigators to date between 50,000 and 80,000 yr. B.P. (Leakey et al. 1968), could actually have been produced by "intergranular percussion and pressure at various times during their transportation from out-crops." In a more recent article, Haynes (1988) has referred to such naturally produced objects as "geofacts." He suggests that the abundance and random distribution of these items at the site reflect their natural origin. Payen (1982), applying a test based on the probability that a lithic assemblage of natural origin would be characterized by high frequency of obtuse platform-scar angles and one of cultural origin would be characterized by a low frequency of such scars, demonstrated that the Calico assemblage better fits a naturally produced assemblage. Payen (1982:201) concludes that the "Calicoliths are geofacts, not artifacts." In a more recent article, Simpson (1986) reviews the lithic assemblage from a functional perspective (i.e., noting edge wear and flake scar patterns) and recognizes a number of unifacial tool types. Obviously, the jury will be out for some time yet concerning the origin of the Calico site lithics.

Could an argument for a natural origin for the small flakes from North Cove be valid? Flotation of more than seven cubic meters of deposits at the site did not yield an abundance of natural cherts. The sedimentary matrix of the flakes, as noted above, was of much finer material. While it is true that some small gravels of jasper were noted during this process, none bore scars indicative of spontaneous retouch. All were heavily patinated, alluvial gravels without any evidence of the kind of natural percussion described by Haynes and Payen. Against this background, the lithic artifacts we recovered stand out as anomolies, not as the result of a biased selection of "classic" flakes from a greater number of less-modified gravels. I contend that the flakes were produced by human activity and that their provenience at North Cove reflects redeposition from a site of pre-Clovis age in the vicinity. Given the gradient of the deposits revealed in the test units, the site of primary origin was probably located upslope and may well have been destroyed by erosion. One could hope for more conclusive evidence of human activity, such as retouched lithics or formal tools. At the same time, I find it unsatisfactory to simply dismiss these finds as the result of an as yet undemonstrable natural process. Their attribution to human activity in the Republican River Valley during pre-Clovis time is the most viable hypothesis.

Chapter 7

SUMMARY AND INTERPRETATION

Mary J Adair

Investigations at the North Cove site (25HN164) have yielded data significant to archaeological, paleontological and paleoecological research. Excavations have recovered a collection of vertebrate and invertebrate remains from both Late Wisconsinan and Holocene age deposits, species of which had not previously been recorded as a fossil from the central Great Plains. Pollen and phytolith remains from Pleistocene sediments indicate a local vegetation of mixed spruce-deciduous parkland in a spring valley setting. The occurrence of aspen and relatively high frequencies of non-arboreal pollen would suggest a more open, less diverse vegetation such as aspen parkland or groveland in the uplands. Animal species, such as the mountain deer, woodland muskox and bison were well adapted to the open parklands of the uplands. The arctic shrew, snowshoe hare, ground squirrel and bog lemming were perhaps more at home in the sheltered spruce-deciduous valleys. The springs or nearby marshes provided a suitable habitat for fishes, toads, frogs and salamanders. These remains point to the existence of several Late Pleistocene econiches present in a setting much cooler and moister than that found in southcentral Nebraska today.

Excavations also yielded human artifacts, creating a very tantalizing dimension to the emerging picture of the Late Pleistocene environment. Five artifacts (one in 1985, four in 1987), one with edge modification, were recovered from the silty clay lens of Late Pleistocene age. The exact age of the artifacts is unknown; however, sediments overlying the silty clays have provided stratigraphically consistent radiocarbon dates between 14,700$\pm$100; and 10,580$\pm$2200 yrs BP. The artifacts therefore predate the organic spruce zone from which the dates were taken and fall into the temporal category of pre-Clovis. Such a temporal association cannot be considered lightly, given the accumulating body of data supporting the existence of such a cultural period in North America, as well as the continual refusal of several prominent archaeologists to accept any of the data (see Chapter 6). In some respects the North Cove site is not unique in its Paleoindian occupation: the artifacts and their context are clearly not as perfect as one would like, but their presence and association with an incredible amount of paleoecological and paleoenvironmental data cannot simply be dismissed.

Two factors immediately label the artifacts as controversial. First, they are not formal tools. Four of the five artifacts are small unmodified flakes, a size usually associated with resharpening or pressure flaking, while the retouched quartz tool was not manufactured from a true flake. Second, the artifacts were not recovered in their primary context, but instead redeposited from an original upland location into sediments of a former spring. The original upland location is probably not far from the location of the field investigations, but exactly where is unknown. As discussed in Chapter 3, a paleochannel of the Republican River, once flowing on the Cretaceous age Pierre shale, was abandoned between approximately 14,000 - 12,600 years ago. It was in the abandoned channel that the spring and an associated body of open water developed and persisted for several hundred of years. During this time. the small artifacts and burned bone of a probable bison were redeposited from their original context. This original context would have been the pre-Clovis site. The late Pleistocene landscape has changed significantly and is present today at the North Cove site in the various stratigraphic horizons. An image of this former landscape was critical to understanding the context of the recovered artifacts.

Despite these rather imposing factors, the North Cove site cannot be dismissed as a site that once was but is no longer. Let us consider several points. First, there are no diagnostic tools associated with the pre-Clovis period in North America. The modified flakes recovered from North Cove may indeed be representative of this period, although admittedly a larger tool would be more consistent with artifacts recovered from other possible pre-Clovis sites in the Great Plains. The unmodified flakes are regarded as products of human behavior. While they often become the insignificant artifacts in most archaeological assemblages, at North Cove they become critical. We strongly believe that the artifacts from North Cove represent a human occupation. While they may not be as good as one would like, they are cultural. In addition, the presence of burned bone (probably <u>Bison</u>) is a very strong indicator of previous human activities. It is very unlikely that this bone was burned by some natural process. Second, despite their redeposited context, the artifacts can be placed in their correct geomorphic and temporal context. There is no doubt that they are at least older than the most recent radiocarbon date from the spruce zone (10,580 yrs BP) and more likely predate 14,700 yrs BP. Various forms of turbation and redeposition are constant forces acting on prehistoric artifacts and often become increasingly significant when a Paleoindian site is discovered. At the North Cove site, the secondary context of the artifacts is well understood, and it does not change their temporal association. Since we do not, and could not, know the primary location of the human occupation, it is possible that continual erosion of the cliff face may expose additional artifacts. As erosion and wave action cut further back into the deposits, the primary upland location may be visible. Third and final point, the site has provided an overwhelming amount of paleontological and paleoenvironmental data. Identified plant and animal species have literally changed our understanding of the late Pleistocene environment of the central Great Plains. No other known site has come close to providing the recorded and potential information documented from North Cove.

A recommendation for National Register eligibility cannot be made for the North Cove site on the basis of the archaeological data recovered. The secondary context of the artifacts unfortunately indicates that the investigations did not disclose the pre-Clovis occupation itself, but instead the redeposited evidence of this occupation. It is unfortunate that the National Register of Historic Places is restricted to sites that have a demonstrated human presence, since the North Cove site has yielded data significant to paleontological and paleoenvironmental research.

In conclusion, this should not be the final chapter on the North Cove site. Given the continual forces of erosion and wave action, more of the site may some day be exposed. While deep coring in 1985 and the 1987 excavations both indicate that the spruce zone does not extend much further back into the cliff, the silty clay lens are present. These are the horizons from which more cultural data could be extracted. It is recommended that the Corps monitor the site on an annual basis, noting the amount of erosion and exposure of additional cultural or paleontological data. Further data recovery should be made possible if cultural materials are exposed. In addition, further research by other institutions or private funding should be strongly encouraged. That is, the Corps should allow investigations to be conducted on their property, since continued investigations of all horizons at North Cove can lead to an even greater understanding of the paleoenvironment and human adaptation.

*

Glossary

Anteroconid - Anterior part of tooth cusp.

Arris - The intersection of two surfaces forming a crest or spine formed by unifacial or bifacial flaking. The longitudinal lines of an artifact that is rhomboidal in transverse section (Crabtree 1972).

Artifact - Any object altered or used by humans.

Arvicolids - Voles, mammals.

Biogenic Opal - Silicious body particle of plants.

Bulliforms - Type of plant cell.

Catostomids - Suckers, fish.

Cementum - Part of a tooth.

Chloridoid tribe - Xeric, short grasses.

Chrysostomate cysts - Algae-like silicious shell, plant part.

Complex - Refers to a cultural manifestation without being committal to any particular taxonomic designation.

Culture - All learned behavior that serves to organize individuals into a community or society.

Cut bank - An exposed vertical soil column resulting from wave action, erosion and road cuts.

Cyprinids - Minnows.

Diagnostic artifact - An item representative of a particular culture or time period.

Diatoms - Skeletons of plants.

Eragrostoideae subfamily - Cool weather grasses.

Erralieure - An enigmatic flake formed between the bulb of force and the bulbar scar. The erralieure flake is convex, concave (Crabtree 1972).

Feature - The location of specific activities (e.g., fire-pits, storage pits, petroglyphs, burials) that are recognized only in the field.

Flotation - Water separation of heavy soils from light plant and animal remains.

Foramen - A hole in a bone.

Four (4)-element M2 - A second molar with four cusps.

Frontoparietals - The frontal and parietal bones of the skull of an animal.

Geomyid - Pocket gophers.

Holocene - Recent, or post-glacial epoch dating from 10,000 B.C.

Ictalurid - Catfish.

Infraspinous fossa - Portion of a scapula blade.

Lagomorph - Rabbits and hares.

Lingual reentrants of M3 - Pertaining to enamel fold on the tongue side of the third molar.

Lobate - Phytolith with lobes.

Loph - Tooth fold.

M1 - First molar.

M2 - Second molar.

M3 - Third molar.

M1-3 - First through third molars.

Macrobotanical - All plant remains that can be seen with the unaided eye but that are usually identified with a microscope.

Macrofaunal - All animal remains that can be seen with the unaided eye.

MNI - Minimum number of individuals.

NISP - Number of identified specimens.

Paleosol - A buried soil horizon of a prior land surface.

Panicoideae - Type of grasses.

Parietal spurs - Bony ridges on the parietal bone of the skull of animals.

Pleistocene - The most recent geologic epoch, known as the Ice Age.

Pleniglacial - Pertaining to the maximum of a glacial or stadial pulse; full glacial.

Poaceae - Grasses.

Posterior - Pertaining to the rear or back of an object.

Potlid - A plano-convex flake that leaves a concave scar. They result from differential expansion and contraction of lithic material caused by heating (Crabtree 1972).

Profile - A schematic drawing representing soil stratigraphy.

Quaternary - A geologic period consisting of both the Pleistocene and Holocene epochs.

Sciurids - Squirrels.

Site - Any location of human activity.

Spong spicules - Silicious particles, internal skeleton, part of a plant.

Stizostedion - Sauger.

Stratigraphy - The arrangement of soil strata.

Topotypic - Pertaining to the typical.

Tricomes - Vascular system of a plant cell.

Two-Creekan - A North American mid-continent time-stratigraphic term denoting sediments deposited during the substage of the Wisconsinan Stage dating from 12,500 to 11,000 YBP.

Vaulting - Arched.

Wisconsinan - The last major glacial advance of the Ice Age dating from 90,000 B.C. to 10,000 B.C.

Woodfordian - a North American mid-continent time-stratigraphic term denoting sediments deposited during the substage of the Wisconsinan Stage dating from 25,000 to 12,500 YBP.

Zapodid - Jumping mice.

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